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EDITORIAL NOTES.

Economy in Sulphate of Ammonia Production.

In dealing last week with the subject of the new Sulphate of Ammonia Makers' Association, and the necessity, under current conditions, for such an organization, reference was made to the extension of the contribution to the supply of nitrogenous fertilizers by what is being done on the Continent with the process of extracting nitrogen from the atmosphere. It will be remembered that Messrs. Bradbury and Hirsch in their last annual report briefly discussed the question of the competition of atmospheric nitrogen fertilizers, and pointed out that, these being primary products, their rate of production must be determined by their own selling price, as in the case of nitrate of soda. An essential to production is cheap electrical power; and the cheapest power is to be obtained where water energy is available. There is no doubt that, wherever this is procurable, there in time will plants be erected; and this will have effect upon the foreign markets for sulphate of ammonia, as well as for nitrate of soda. But Messrs. Bradbury and Hirsch mentioned as an alleviating circumstance that, where coke and gas are produced, sulphate of ammonia will continue to be made whatever the selling price, and that this will ultimately compel some regulation of the output of the atmospheric nitrogen plants. This is satisfactory so far as it goes. But the question is as to what will be a profitable selling price for the atmospherically derived fertilizer. This can only be gauged after knowing what are the costs per ton of production. Some people speak of them as low. Those running the plants do so. But there is nothing definitely known regarding the costs; so that at present we are quite in the dark as to the financial aspects of the business. As mentioned last week, £4 per ton is cited as the cost of production; others mention higher figures. These are, however, all more or less conjectural. Anyway, £4 is the round figure mentioned by Mr. Thomas Glover, in his recent Presidential Address to the Southern Association, as the cost of producing a ton of sulphate of ammonia on gas-works, after obtaining the ammoniacal liquor. It would not be a matter over which there would be any the less thankfulness in the coal-carbonizing industries, if it were found that the costs of the atmospheric nitrogen processes were considerably higher than they are represented to be, as then competition would be on lines more favourable to sulphate of ammonia.

However, with the descent of market prices, and with the new sources of nitrogenous fertilizers, with a prospect of having to compete at lower prices, gas engineers will be making further inquiries to see whether they cannot place themselves in a better position, by producing sulphate of ammonia at still lower cost, and by realizing as much as possible from this source per ton of coal carbonized. The only methods of achieving the latter that have yet been advanced are the prevention of losses of ammonia from gas-works plant and liquor storage tanks, and contributing, by the use of charges nearly filling horizontal retorts, to the protection of ammonia from decomposition by radiant heat and the long passage of gas through, and in contact with, incandescent coke. But there is the question of more economical production; and we do not think that, in these days of lower illuminating standards, and the setting-up of calorific standards, the system of the direct production of sulphate of ammonia has been sufficiently investigated by the gas industry in relation to town gas. Mr. Glover, in the address already referred to, stated that the ordinary £4 cost per ton for sulphate of ammonia production (subsequent to the liquor being obtained) stood as against £2 by the direct method. This statement requires very careful investigation, because it represents a considerable saving to a gas-works. There are several other points that call for thorough examination, to ascertain what is actually the net difference in cost, in view of the radical alteration that the process would entail in a gas-works system, from the condensing plant up to the purifiers. There is also the point as to what difference, if any, the direct process would make in the way of throwing additional work upon the purifiers. The effect on gas quality is another matter that needs investigation, although it must be confessed that, with the weak acid solutions used, the coke-oven gases do not now show that there is any very material depreciation of the illuminating constituents. However, if there is substantial economy in the direct system, we ought to know more about it. But at the present time, as applied to a gas-works system (other than small ones), there is little experience; no balance-sheet is available showing savings; and no complete evidence is at hand as to effects.

Short-Sighted Councillors at Widnes.

It is an excellent thing for communities generally that the business of local government is not left entirely to men whose knowledge and outlook are so limited that they cannot properly appreciate what constitutes good service, and what is best for a town. The variety of intelligence and ability in a local governing body is really the only immediate protection that communities have against that defect of some councillors—short-sightedness, as the variety helps to bring about counteracting influences. An illustration of the truth of these remarks is furnished by certain proceedings at the meeting of the Widnes Town Council last Tuesday, when the Gas Committee, on the advice of their Engineer and Manager (Mr. Isaac Carr) proposed further reductions in the prices of gas for domestic and industrial purposes. The Widnes Gas-Works are run not with an eye to providing profits in aid of the rates, but with the better object of providing cheap light, heat, and power for the people and industries of Widnes, and so causing the service to contribute to its maximum capability to the welfare and prosperity of the town and district. The Gas Committee, chiefly through the economies produced by the new carbonizing plant at the works, proposed to make a present to the consumers of £2600 a year by way of reductions in price; and they can well afford to do this, in view of the amount of profit made last year, despite the retarding factors of dearer coal and lower market values for residuals. Mr. Carr's suggestion as to reductions was that the price to ordinary consumers should be lessened by a further 1d., making it 1s. net per 1000 cubic feet to all consumers below 3 million cubic feet; to consumers above 3 millions, 10d. net; and to users of gas for motive power 8d., net. The prepayment consumers he also proposed should get an increased amount of gas for 1d.—the present 54 cubic feet being raised to 66·6 cubic feet. Free inspection and maintenance of modern incandescent burners he further suggested should come into force; only materials being charged for. The proposals, we may say at once, were adopted; and the figures will make it more difficult than ever for other gas undertakings to displace the remarkable lead of Widnes—a lead which applies to the whole world—in the matter of low-priced gas. In view of the profits made last year under adverse market conditions, the Gas Committee were quite justified in endorsing the recommendations made for the benefit of the community generally.

But it was the 8d. net to power users that appears to us to have been the cause of a complete exposure, on the part of two of the councillors, of either their inability or their temporary failure to grasp the true position of things. It was the unsafe law of averages that tripped them up; and Mr. Councillor Millar (who will pardon us entertaining an opinion as to his talk to the gallery being rather stupid) and Mr. Councillor George Davies (who will excuse us thinking that his use of the word "vicious" as applied to the action of the Gas Committee better fits his own speech) will perhaps see, on further consideration, that they took a part in

opposition to the proposal that a greater depth of knowledge would have enabled them to avoid. The law of averages ought never to be applied in determining fairness or otherwise to differences in condition. That was where the mistake was made, particularly by Mr. Davies. The average total cost of Widnes gas last year was 9·9d. per 1000 feet; and therefore in the 8d. Mr. Davies espied an undue consideration for the power consumers, and an injustice to the other consumers. We should be very pleased if the advantages in regard to gas enjoyed by the "other consumers" of Widnes were enjoyed by us in London and the suburbs.

Analyzing the accounts of the Gas Department, it is easy to see that, without the power business, even at 8d. per 1000 cubic feet, the other consumers would not be so well off as they are to-day, and will still be in the future. The actual manufacturing and distribution costs amounted last year to 5·5d. per 1000 cubic feet. The difference between this and the 9·9d. represents the average standing charges; but the incidence of the standing charges varies with each consumer. That is a point that the hostile Mr. Davies (we may dismiss Mr. Millar from consideration), who took his stand on the total average, evidently did not appreciate. It was, judging from his words, obviously quite beyond his information and grasp that the proportion of the standing charges would be exceedingly small in the case of power consumers using (say) 10 to 12 million cubic feet a year, and drawing upon the supply continuously, and not with the intermittency and quantitative variability found in the case of ordinary and prepayment consumers. The one class of supply involves less cost than the other. It is indeed surprising that Mr. Davies should not have appreciated a fundamental point such as this in commercial calculation and policy, and so kept himself free from the really absurd position in which he appears to have placed himself. The average of 9·9d. per 1000 cubic feet embraces hundreds of small consumers who, if they were debited with their proper proportion of standing charges in relation to consumption and intermittent periods of supply, would have to pay anything from (say) 2s. 6d. up to probably 7s. 6d., and more, per 1000 cubic feet. But they are not called upon individually to pay their fair proportion; and one of the reasons that enable the Gas Committee to allow all the private consumers to enjoy low prices for their gas is the working and financial advantage that the undertaking obtains from the good and continuous custom coming from the power users.

To the power consumers, then, the intermittent domestic consumers owe a debt of gratitude; and therefore neither the power consumer nor intelligent administration deserves to be plastered over by unintelligent and ineffectual criticism. It was a pity Mr. Alderman Timmis, J.P., the Chairman of the Gas Committee, was unable to be present at the meeting of the Council last Tuesday, as he would, we know from his reported utterances on previous occasions, have been able to dispense a little educative information on the subject of the incidence of standing charges, from which the misinformed critics would have certainly derived some benefit. In conclusion, we must congratulate the Gas Committee and Mr. Carr upon the further stability that they have put into their unique position in regard to gas prices, and the consumers of gas in the borough upon the cheap service rendered to them, and upon the just discrimination made as to differential charges according to custom.

A Prepayment Minimum.

The paper upon the prepayment system that Mr. John Carter read at the meeting of the Eastern Counties Gas Managers' Association in April, and on which some criticisms were passed in the "Journal" at the time, has attracted much attention, not only at home, but beyond our shores; and, when the author reflects upon the matter, it must appear to him somewhat singular that everybody but himself has misinterpreted his words and intentions—at all events, so we gather is his view from the letter that is given in our "Correspondence" columns, commenting on the critical article that appeared from the pen of Mr. Norton H. Humphrys in our columns on the 2nd inst. It is meet that the gas engineers of two cathedral cities should deal with the question of prepayment equity raised by one of them. The point is also referred to in an article by Mr. D. Stavorinus, of Amsterdam, published in this issue; and Mr. Carter will observe that even his colleagues of Holland have been under the impression that he has charged a powerful industry with acting oppressively, and therefore unjustly, towards prepayment consumers.

The whole of the article by Mr. Stavorinus has interest on account of the many particulars that it furnishes of the mode adopted for treating prepayment consumers in Amsterdam; and these consumers may regard themselves as highly favoured by the amount of convenience supplied to them for a very small excess upon the charge made to the ordinary consumers. The point, however, that strikes us as most interesting is the one which describes how there is provision in Amsterdam for producing in one direction equality between the prepayment consumers. The plan is simply this: The price of gas to ordinary consumers is 7 cents, and to prepayment consumers 7½ cents, per cubic metre, which prices are respectively equivalent to approximately 3s. 3½d. and 3s. 6d. per 1000 feet. When Mr. Carter reads that in Amsterdam the prepayment consumer gets much more than he gives in Lincoln for an excess of 2½d. per 1000 cubic feet above the charge to the ordinary consumer, he will be decidedly envious, until he learns later in the article that, to cover all the expenses incurred on behalf of the prepayment consumer over and beyond the charges attributable to the ordinary consumer, the excess should be at least doubled. This brings us to the point where all prepayment consumers up to 17,500 cubic feet per annum have to provide an equivalent sum in excess payments. The consumption mentioned is regarded as a minimum; and if a consumer's patronage does not reach it, then he or she has to pay ½ cent. per cubic metre, or 2½d. per 1000 cubic feet, for any deficiency. Thus all prepayment consumers are obliged to pay in excess 4s. 2d. a year, whether or not their consumption reaches 17,500 cubic feet. Where the system fails in equity (it fails in equity all along the line as between prepayment consumer and ordinary consumer) as between prepayment consumer and prepayment consumer is only above the 17,500 cubic feet minimum. Mr. Stavorinus writes: "Only when the yearly "consumption of the prepayment consumer exceeds con-"siderably the fixed minimum is he at a disadvantage." We think that he is at a disadvantage, in comparison with the smaller prepayment consumer, directly he begins to pay more than the 4s. 2d. excess a year, apart from which he is, through the gas he consumes, a more profitable customer than those who burn less.

Anyway, the system is admirable up to the point of 17,500 cubic feet; but it would be, we imagine, very difficult to introduce it after the prepayment business had become so firmly established as it is in this country on a uniform price, and no extras beyond the penny or shilling placed in the slot. If the system of a minimum consumption, charging the excess for any deficiency, had been started in this country at the advent of the prepayment business, we have no doubt it would have been accepted quite as a right and legitimate condition as it is in Amsterdam. But our system has become a convention, just as much as has the Amsterdam one. The latter, however, would have been a better practice than that adopted by Mr. Humphrys at Salisbury. He stated, in his article of June 2, that the prepayment consumer is made to understand that he is expected to use not less than 10,000 cubic feet of gas per annum, and that, if he does not do so, the whole of the fittings may be removed. Mr. Humphrys also speaks of an "annual weeding-out." It would be a good thing if consumers showing a deficiency in consumption could have the choice of being disconnected, or of paying the difference in excess between their registered consumption for the year and the 10,000 cubic feet. They might prefer paying 3s. or 4s. to being quite deprived of the use of gas. There, however, come in those inexorable model clauses, over which the parliamentary authorities are so scrupulously jealous. The fixed maximum excess per 1000 cubic feet in the model clauses prohibits such adjustment being made. Suppose an excess of 9d. per 1000 cubic feet and a minimum point of 12,000 cubic feet, we doubt very much whether the parliamentary authorities would tolerate a consumer (say) of 6000 cubic feet a year being charged six ninepences in addition. Yet it would only be fair to the prepayment consumers who through patronage pay up to the minimum point. We should like to see what would be the effect if the promoters of Bills next session made provision for obtaining this power as to a minimum, and argued the matter out before the parliamentary authorities. The power would, however, have to be accompanied by another provision—that all excess money paid above the fixed minimum consumption should be returned to the consumer. The suggestion provided by the Amsterdam experience is, to say the least of it, an interesting one.

Cheaper Domestic Boilers or Higher Efficiencies.

THE demand is constantly being made for cheaper and yet cheaper gas-heated circulating-boilers. The demand should not be pressed so far that, in the result, a much cheaper class of apparatus is put on the market which shows a considerable falling away from the greater efficiencies of the higher-priced boilers, or there may be discontent on the part of users, which will not be a good thing in view of the promising field that water heating by gas now presents to the industry. In our columns this week, Mr. Thomas Potterton points out, through the results of tests that he has made, that the cheaper circulating-boilers on the market to-day (his own he frankly admits are included) do not show the same efficiency in the shape of B.Th.U. per cubic foot of gas consumed transferred to the water as do somewhat higher priced goods; and when he tells us that there is no help for this—that the cheaper boilers cannot be made of the design necessary (we need not enter into details) for securing a higher temperature return from the gas consumed—then it is time to consider the question as to whether the lower first cost really means prospective cheapness to the user. We know that Mr. Potterton contends that it does not; but the makers have perforce to yield to the insistent demand for the cheaper class boilers. To this cheapness somebody has to be sacrificed, and that somebody is the user of the goods.

Take two of the cheaper forms of circulating-boilers which were placed under test. In the one case (the water varied a little in its temperature at the beginning of the two tests), it was found, at the end of the consumption of 25 cubic feet of gas, that the temperature of the water in bulk was equal to the transference to the water of 328 B.Th.U. per cubic foot of gas used, and in the other case to 288 B.Th.U. In both instances, following on at once while the boiler and system were still hot from the first gas consumed, with the consumption of a further 25 cubic feet of gas, a better result in B.Th.U. transferred was shown. But for our present purpose, the result at the end of the consumption of the first 25 cubic feet of gas is sufficient. Now compare the figures given above with the 424 B.Th.U. and 392 B.Th.U. per cubic foot of gas consumed in higher priced boilers, and there a considerable difference is seen. Take, for example, the 328 B.Th U. and the 424 B.Th.U. (the 328 B.Th.U. not being by any means the worst figure for the cheaper boilers), we have a difference of 96 B.Th.U. per cubic foot of gas consumed. Multiply this by 25 cubic feet; and the answer is 2400 B.Th.U. Apply this difference to the quantity of hot water required by a household throughout the year, and the loss, through first cheapness, becomes a substantial amount, which would much more than supply recompense for the higher first cost.

This point as to first cost and efficiencies is an interesting one. The trouble is that people are often frightened from buying a really good thing on account of the initial cost; and the fact that the losses represented by the lower efficiencies (although continuous when the boilers are in use) are not presented to them in concrete form, but are attenuated by the factor of time, often induces them to go in for a cheaper article, though it may be the dearer in the long-run. The managers of gas undertakings are in a different position. They can wholly appreciate the point made here; but they, too, in many cases, are inclined (though they know full well it is not good policy) to let the consumer, in this matter of bulk water heating, bear loss by putting out on hire the cheaper appliances. We are certain that this, in numerous instances, is not sound policy. There are many consumers who would willingly pay a little more in quarterly rental if they could be shown a permanent saving through the higher efficiency of a somewhat more expensive type of apparatus. The question is one that at the present time is well worth consideration.

New Features at Liverpool.

No gas engineer should be in Liverpool this week without visiting the fine Linacre works of the Liverpool Gas Company. The visit will well repay them, if only to make acquaintance with three or four of the novelties there. These novelties are referred to in the President's address published in this issue as well as in the general description of the Liverpool works; and two of them have special articles devoted to them. At the Linacre works are to be seen four different methods of retort-house operation, including working by Arrol-Foulis machines, Fiddes-Aldridge machines, and Glover-West verticals. The Fiddes-Aldridge machine in operation here has a chain that complies with the requirement to-day for heavy charges; and this one can negotiate a charge of no less than 16 cwt. The telpher track is also a feature. Here too is to be seen Professor Carl C. Thomas's electric meter, which we believe is the only example of such a meter to be seen at a gas-works in this country. The modest size in relation to its measuring range is one of the surprising things about it. The space occupied by it is no greater than the size of the pipe through which the gas passes on its way to the holders; and yet its registering capacity varies from 60,000 to 750,000 cubic feet of gas an hour. Its registrations are stated to be most accurate. When the members return home from Liverpool, they will find in the "JOURNAL" for Jan. 21, 1913, a paper on the subject of the meter by Professor Thomas, the inventor. Another thing that should be inspected is the mechanical grate fitted to one of the generators of the carburetted water-gas plant by Messrs. Humphreys and Glasgow. By means of this invention, there is regular and effective removal of the clinker; and this enables the work of gas making to be carried out with increased economy and efficiency. Manual clinkering is altogether dispensed with; and the workmen are relieved from a very laborious task.

Cooling Coke in Air-Tight Vessels.

The greatest novelty to be seen at the Linacre works is the "Dryco" plant, about which we publish to-day some extended particulars and illustrations. There is a growing recognition of the fact that a large expansion of the trade in coke will be best accomplished by improving the quality; and one way of doing this will be to supply coke as free from moisture as possible and of good physical properties, so as to give the user excellent heating value for his money. The experience of gas-works is that moisture-free coke commands a higher price than ordinary water-saturated coke; and this has to be put down to the credit of the system. The system (which is the patent of Messrs. Allen and Gibson, and is being commercially handled by Messrs. Aldridge and Ranken), is a simple one. The coke is pushed into specially constructed containers, into which neither water nor air can find way. The containers are raised and transported by the telpher system, and lowered into a special form of water-tank, where they are allowed to remain about three-quarters of an hour. The retort-house is thus kept free from the steam and fumes that arise from ordinary crude forms of quenching. This is worth something. But the first question a gas engineer will ask is, Will it pay? The time occupied in the work is no doubt somewhat longer than is customary under the old form of quenching; but the system is so much of an automatic nature that it seems to us there should be a credit from the labour point of view. Regarding capital expenditure, a system of some kind for coke removal and quenching must be employed; and so there can be little in the point as to initial cost. The resultant coke has a greater heating value than coke containing a high percentage of moisture. Less breeze being produced, and a sound physical texture being maintained, screening is quite unnecessary. Less water, too, is required for quenching; and so there is a saving there. On a heating value basis alone, the article elsewhere shows that the coke is intrinsically worth to the consumer 1s. 9d. per ton more than direct water-quenched coke; and it is found that consumers are quite prepared to pay a higher price. The saving through less breeze being produced, and screening, with its attendant expenses, being eliminated, is put down at 1s. 2d. per ton. So here we have an estimated reduction of costs, with a higher market value to add. Certainly the case put forward for the "Dryco" system (which case is not wholly presented here) is an attractive one; and, judging from this case, there should be money in it for the user—especially when an improved gas-works coke is imperatively necessary if the demand is to be increased by the recommendation of merit.

That Growing Stock at the B.C.G.A.

Some extracts from a report, prepared by the Executive Committee, dealing with the progress of the work of the British Commercial Gas Association are published elsewhere to-day; but the chief interest of the document, in our opinion, is to be found in the appendix. Appendices are sometimes useless and troublesome things; but this particular one strikes us as being

most informative as to some of the work that goes on behind the scenes in connection with the Association. It is constituted of items comprising a brief summary of matters on which service has been rendered to subscribing concerns; and it indicates the large variety of subjects on which advice is sought and given—with frequently the desired result. The organization being the repository of an ever-accumulating stock of knowledge on all sorts of topics, its sides must by this time be bulging out tremendously with valuable docketed material upon which hands can be promptly laid as required. This side of the Association's work must not be overlooked by gas undertakings. Of course, it would be injudicious to mention all matters on which information has been sought, and assistance afforded; but we know that, while the Association have not always scored in what they have done, they have often done so, and saved the situation by the information they were able to give, where the local management, with more limited knowledge of the subject, would, in all likelihood, have failed.

Magisterial Censure and Public Convenience.

Magistrates, like other people, are only human, and so are liable to err. The learned Magistrate who presides at the Old Street Police Court, in our opinion, commits a serious error, when, publicly and in the presence of a prisoner proved guilty of having committed the wrong of having first filed a padlock of a prepayment gas-meter and then stolen the money in the box, he turns the blame for what has happened largely on to the meter itself. The very act must appear to the disordered mind of the thief to be an expression of magisterial sympathy towards himself, and must serve in a measure as an encouragement to others criminally inclined. The Magistrate, in the case reported elsewhere, said these prepayment meters manufactured criminals wholesale, and should be suppressed by Act of Parliament. We should imagine that, before coming in contact with an innocent gas-meter, the criminal had already been manufactured who would deliberately take a file, and sever the shank of the padlock, in order to secure the money from the meter-box. The meter had no part in the "manufacture" of that criminal. Vice was already there, and the meter was the object on which vice was exercised.

Suppression by Act of Parliament.

We shall next have His Worship asking for the suppression by Act of Parliament of ladies' pockets and handbags, Selfridge's and other places where goods are exposed for sale, and the carrying of watches, because ladies' pockets, bags, the big emporiums, and watches only "manufacture" criminals wholesale Modern methods of locomotion should also be suppressed by Act. of Parliament, and a return made to the slow cumbrous methods of the past, because the number of accidents is greater with the modern means. The Magistrate, it seems, would like to throw half the gas consumers of the country back into the dull old days of oil-lamps and candles. In the prepayment gas-meter, we have a popular public convenience, which no Parliament would care to remove, for there would at once be an indignant outcry and protest throughout the country. Gas suppliers are doing their best, by gradually bringing about the use of stronger cash-boxes as also by protected locks, towards stopping the attacks of criminals or people of criminal tendency upon them. But it would make the system impossible, if in every poor house gas companies had to provide a burglar-proof meter. The cost would be so immense, that the economy to the poor consumer of the prepayment system would be largely lost. We cannot help questioning the wisdom of the remark made by the Magistrate in question; and certainly this is one of the things upon the practical side of which he has failed to look.

An Inglorious Victory.

Mr. Justice Warrington has been engaged in attempting to settle a difference that has arisen between the Swansea Gas Company and the Swansea Rural District Council, regarding an agreement entered into in 1909 for the supply of gas to, and the lighting of, certain territory. The case so far has gone against the Company. The circumstances under which it has done so are peculiar. Over part of the district involved in the compact with the Council, the Company had no statutory powers in 1909; but they undertook to obtain them. The Council, on their part, agreed that for a certain period they would not, in the districts in question, supply electricity, under the powers they possessed, other than for power purposes. The Council appear to have completely changed their minds in connection with the agreement; and subsequently developed a desire not to stand by its terms, but to wriggle out by any means at their disposal. No stone that could be turned has been left unturned to that end. In the first place, they submitted that the agreement of 1909 was *ultra vires*, because the Company had not, at the time it was entered into, powers of supply over certain parts of the area. But Mr. Justice Warrington rather rebuked them on this point, by reminding them that it was part of the agreement that the Company should apply for the necessary powers. The Council's first contention therefore failed.

A Legal Point and One of Recollection.

The second point in the tactics to obtain relief from the agreement was to submit that it was not binding because the Council, by section 11 of the Electric Lighting Act, 1882, were prohibited from divesting themselves of the legal powers given them, or of any legal liability imposed upon them, by their Order, without the consent of the Board of Trade. The Gas Company's contention, which appears to be a perfectly reasonable one, was that to "divest" of the powers meant to part with them by transference, and that was not done in this case. His Lordship, however, was with the Council on this point. The last point made was that, when the Gas Company applied for the necessary powers in 1910 to enable them to carry out the agreement, an understanding was arrived at that the provisions of the clauses should supersede the agreement of 1909. The Company submitted that this was not so, and that the clauses only modified, but did not supersede, the 1909 agreement. His Lordship found some difficulty in determining this matter; but he finally came to the conclusion that the understanding was that the original agreement should become inoperative. It is a singular thing that, so soon after the agreement was made, and one of the purposes of the Company's Order being to enable the carrying through of the agreement, there should have been any notion on either side of abrogating it. On two out of the three points, therefore, the Council succeeded. They entered into the agreement of 1909 with their eyes open; and nobody appears to have suggested to them that by what they were doing they were exceeding their powers. All the comment necessary upon the matter is that, having regard to all the circumstances, the victory of the Council is not a glorious one.

Compulsory Co-Partnership.

Another addition has been made to the attempts to further the cause of co-partnership by legislation; the author being Mr. O'Shee, M.P., who has introduced a Bill with the object of making provision for rendering the adoption of the system compulsory. The idea is that the Board of Trade should be empowered, on receiving a requisition signed by not less than one-half of the persons employed by a statutory or other company, to appoint an arbitrator to reconstruct the company or undertaking on a co-partnership basis. The claims of the shareholders are to be satisfied by the receipt of a preference dividend equal to the average return during the three preceding years; and they are to be entitled to elect two directors for every one that the employees would be authorized to appoint under the scheme. Further, the arbitrator is to determine a maximum dividend for the shareholders, as well as a minimum wage for employees over twenty-one years of age who are not learners. Then there is to be provision for reserve and depreciation; and after this one-third of the net profits are to go to the shareholders and two-thirds to the employees, in either £1 ordinary shares (carrying not more than 4 per cent. interest) or in cash, or both, in a specified manner. In any year in which the preference shareholders receive the maximum dividend, the whole of the net profits after such payment and after payment of a dividend not exceeding 4 per cent. on the ordinary shares shall be distributed among the employees. In the election of directors, holders of ordinary shares are to be entitled to vote with preference shareholders. Voluntary co-partnership is also provided for, as the Board of Trade are to be empowered to authorize undertakings other than those the Bill applies to, and also municipal and other public bodies, to adopt co-partnership or profit-sharing in accordance with regulations to be prescribed by the Board, or fixed by an arbitrator. Certainly, voluntary co-partnership is preferable to anything which may be legally imposed.

THE INSTITUTION OF GAS ENGINEERS.

MEETING JUNE 16 to 19, 1914.

PRESIDENTIAL ADDRESS DELIVERED

BY

Mr. EDWARD ALLEN, M.Inst.C.E.,

Engineer of the Liverpool United Gaslight Company.

Introductory.

Gentlemen,—Although this is my Inaugural Address as President of this annual session, I also realize that the close of the session will terminate my office as President of the Institution, and therefore in that sense some of the sentiments expressed must be of a valedictory nature.

In the first place, therefore, permit me to assure you of my profound sense of the honour you have conferred upon me by electing me to control the operations of the Institution during the past twelve months, and to preside over this important conference. I cannot but feel that while my personal qualifications have had a large measure of influence with my fellow-members, my position as Engineer to the Liverpool Gas Company has operated greatly in placing me in this honourable position.

From the early days of the gas industry, the Liverpool undertaking has been prominent, and is to-day the largest provincial gas company. The success of the Company and the high reputation it has achieved must be largely ascribed to the outstanding genius of the late Mr. Alfred King, and his son Mr. William King, under whose guidance its operations were conducted during the long period of 78 years—from 1826 to 1904.

The late Mr. Alfred King was one of the pioneers in the manufacture and distribution of gas, and takes his place with Barlow, Clegg, and others in having made a practical success of the great invention of William Murdoch. The industry owes very much to him for improvements in the processes of manufacture and distribution. He gave the benefit of his inventions to the world, and spent his life in the service of the industry. In Liverpool he well and truly laid the foundations of the gas undertaking, and, together with his successor—Mr. William King—built up a business that commands the respect and admiration of the country, and which is the pride of those who are to-day responsible for its operations.

History of the Liverpool Gas Undertaking.

It appears fitting that on this occasion some particulars should be given of the history and the present condition of the undertaking. In the year 1815, a gentleman of the name of Hargraves, who represented himself as having been Engineer to a London Gas Company, came to Liverpool and called upon several influential citizens with the object of forming a gas company. He was fortunately able to gain the support of a Mr. Varty, a local coach-builder, who took the matter up with so much zeal and ability that on Oct. 16, 1815, the first meeting of the subscribers was held at the "Crown Inn," Redcross Street.

A small plant was erected on Mr. Varty's premises in Dale Street, from which gas was supplied to two large lamps, each containing three lights, situated at the front of the Town Hall. These were first lighted on Jan. 23, 1816, and excited much attention; large crowds of people gathering to see the brilliant illumination obtained from coal gas. Mr. Varty states that he saw several persons touching the iron gas-pipe to ascertain whether it was hot, with the idea that fire was being conveyed through the pipe. Some alarm was caused among the directors of insurance companies, who feared that the use of gas would lead to conflagrations.

This exhibition, and others given in the shop of a Mr. Phelps, confectioner, in Castle Street, and that of a hatter in Dale Street, enabled capital to be raised. Gas-works were erected at the corner of Hatton Garden and Dale Street, and mains laid in the streets during 1816. The first supply of gas to the public took place on Jan. 3, 1817. The capital subscribed in 1816 consisted of £6000, in 200 shares of £30 each; and this was doubled in the following year. The revenue from gas and residual products sold in the first year amounted to £2585. It may be interesting to note that the present capital is nearly two millions sterling, and that last year's revenue almost reached the sum of £700,000.

As soon as possible, the Directors sought, and obtained, statutory powers. The first Act of the Liverpool Gaslight Company, under 58 Geo. III. cap. 66, May 23, 1818, gave power to raise £50,000, in 500 shares of £100 each, and all other powers necessary for carrying out the objects of the Company.

The success of the Company led to the formation of a rival undertaking; and in 1822 a Company came into existance to supply the town with gas manufactured from oil, and works were erected at Rose Hill. The cost of this gas [about 45s. per 1000 cubic feet in the earlier years and 30s. later] heavily handicapped the undertaking; and in 1838 the Company went to Parliament and obtained permission to manufacture gas from coal and any other material whatever. In the years 1843 and 1844, unsuccessful attempts were made to form a third Gas Company, under the auspices of the Guardian Society.

While competition may be good for business generally, this cannot be said of gas undertakings operating in the same area; and the experience in Liverpool was such that ultimately in 1848, by the advice of the corporate authorities, the two Companies amalgamated. Hence the title "The Liverpool United Gaslight Company"—recently altered to "The Liverpool Gas Company."

In regard to the offices, it is interesting to note that those of the old Company were situated in Dale Street from its formation until 1849, when a removal was made to Newington. In 1854 the Dale Street premises were sold to the Corporation, and the present Police Courts were built on the site. The new Company removed their offices from Rose Hill to Queen Square; and in 1849 the business of the United Company was transferred to the very handsome premises already referred to, erected in Newington. This site was acquired by the Cheshire Lines Committee on June 24, 1870, and the Gas Company's business was carried on temporarily in Cornwallis Street until the new offices in Duke Street were entered on July 1, 1872.

In regard to the works, the original installations of each Company were discarded at an early period in favour of more commodious and convenient premises in Eccles Street and Athol Street respectively, situated on the Leeds and Liverpool Canal. Although the plant and apparatus have been replaced from time to time by that of modern design, most of the old buildings continue intact, and remain a credit to those who erected them eighty years ago.

In 1847, additional works were erected in Caryl Street (at that time called Harrington Street) and were opened on the 16th of October, 1847. Then followed the Wavertree works, opened on Oct. 1, 1856, which were the first of the Liverpool works to have the advantage of being connected to a railway system. In Clegg's "Treatise on the Manufacture of Coal Gas," these are spoken of as "model gas-works," because of the methodical arrangement and proportional capacity of the various parts of the plant. The development of Liverpool to the north, which followed the extension of the Docks, and the growth of the township, now the Borough of Bootle, led to the erection of the Linacre Gas-Works, which were opened in October, 1867. The next and latest addition to the works of the Company was at Garston, at the extreme southern end of the area of supply. Gas was distributed from these works in March, 1895. At

present only carburetted water gas is manufactured there (this plant is unique in Europe); but in a short time plant will be provided for the manufacture of coal gas.

Particulars of the plant and machinery at the various works and at the workshops in Kent Street, are shown in schedules appended to this address; and a cordial invitation is given to the members of the Institution to inspect during their visit any of the plant, &c., that may be of special interest to them.

It is, of course, impossible in old works to have everything up to date; but it is the policy of the Directors as far as is practicable, to make use of modern plant and machinery in carrying out the various processes of manufacture and distribution. It may be mentioned that special attention has been given to the question of the efficient and economic handling of materials. The installations at the various works, of steam jib cranes and grabs for dealing with coal, telpher and transporter plants for handling coke, and elevators and conveyors for purifying materials, are found to give excellent service.

Novelties on the Works.

There are a few novelties to which attention may be called.

"*Dryco*" *Plant.*—This plant is in operation at the Linacre station.* It has been at work for the past two years, and demonstrates in a practical manner the possibility of providing gas coke free from water and without the injury that is necessarily caused by contact with water when in a highly heated condition. In the coke thus treated there is an entire absence of small pieces and dust, and its structure being uninjured, it is able to bear a considerable crushing strain; and it has been used in a cupola in the melting of pig iron. It burns freely in an open fire-grate almost without a crackle, and when made from good coal, its calorific value is extremely high.

"*Thomas*" *Electric Meter.*—This is installed at the Linacre station. It is the invention of Dr. Carl C. Thomas, of Milwaukee (U.S.A.), and is the first to be used in this country.† By its means very great volumes of gas can be accurately measured and registered. The capacity of the meter varies from 60,000 to 750,000 cubic feet per hour; and the space occupied by it is not much greater than the size of the pipe through which the gas passes on its way to the holders.

Mechanical Grate.—The mechanical grate fitted to one of the generators of the carburetted water-gas plant at the Linacre station is another novelty. It has been installed by Messrs. Humphreys and Glasgow to meet a great need. The regular and effective removal of clinker by this appliance enables the work of gas making to be carried out with increased economy and efficiency. The difficult work of manual clinkering is dispensed with, and the workmen are relieved from a very laborious task.

Fiddes-Aldridge Stokers.—It is now about eight years since Fiddes-Aldridge machine stokers were introduced to the notice of the gas profession by an installation at the Wavertree works. This trial was so satisfactory that the machines have been largely adopted by gas undertakings at home and abroad. The limitation as to the weight of the charge has, however, militated against it, as there is a growing disposition in favour of heavy charges—not to say full retorts. This matter, has, however, now been successfully dealt with by the patentees. The chain has been fitted with a conveyor, by means of which the charge of coal is deposited in the retort as it is being withdrawn. A trial is being made with the new machine at the Linacre station, and up to the present it is giving satisfaction. The weight of coal per charge is 16 cwt.; and the duration is twelve hours.

There is nothing else of special interest at the gas-works that needs to be referred to in this address.

A Review of the Past Year.

A review of the past year in regard to manufacture does not reveal the adoption of any striking changes in plant and machinery or the processes employed, with the exception of the method of purification successfully carried out at the works of the South Metropolitan Gas Company, and which will be dealt with by Mr. Charles Carpenter in his lecture during this session. I will not attempt to anticipate his communication on this very important subject, but may be allowed to say that it will be presented by Mr. Carpenter with that thoroughness which has ever distinguished all his contributions.

The problem of carbonization is still receiving the closest attention of gas engineers; and the operations of the rival systems are being watched with intense interest. Each claims, and shows, certain special advantages; but in a comparison which includes the cost of installation and working charges, and the results obtained in the quantity and quality of gas, coke, and other residuals, it is difficult to arrive at a definite conclusion that would apply to all cases—local circumstances being sufficient to turn the scale in favour of one system at one place and of another system elsewhere.

For instance, if it is important that the new plant should provide the maximum quantity of gas per diem, the horizontal system would probably be rejected in favour of verticals or coke-ovens; and if a hard coke would not suit that particular locality, then the coke oven would be rejected in favour of verticals. Although the horizontal retort system is the oldest, there are no signs of senile decay, and by the adoption of large settings (say, ten or more of large capacity retorts in a bed) and the employment of the best form of stoking machinery and coke-handling plant, results could be obtained that would compare very favourably with those from other systems.

It is a matter of regret that the Carbonizing Committee of the Institution who were appointed to deal with this subject, have found it impossible to arrange for comparative working tests. Such an undertaking must of necessity be of a very delicate nature; and it is not a matter of surprise that those who are interested in the particular systems are not willing to risk being placed at the bottom of the list because—they would say—of unfavourable conditions or the fallibility of the persons appointed to make the investigations.

During recent years increased attention has been given to the question of condensation and scrubbing, so that the removal from the crude gas of those bodies that are deleterious may be effected without depreciating the finished article, and also that nothing be allowed to remain that would impose an unnecessary burden on the purifiers, or that would go forward and interfere with the functions of the gas as a lighting and heating agent. For example, the sudden cooling of crude gas and its harsh treatment in the scrubbers would deprive it of some of the hydrocarbon vapours that would not otherwise have been extracted, and the absence of which would lessen the value of the gas for lighting and heating purposes. Again, the failure to remove certain condensable vapours before the gas reached the purifiers would result in their deposit among the purifying material, and consequent interference with its power to extract sulphur from the gas.

It is also desirable that the amount of CO_2 in the finished gas be reduced to as low a figure as possible; and although it is impossible to remove the whole without the use of lime boxes, or other means, careful and thorough washing is very efficacious.

Considerable attention is being given by manufacturers of gas plant to vertical washers; and the "Feld" washer has received the flattery of imitation from several quarters. As this type of plant occupies very little ground space, it appeals to those whose area of accommodation is limited, but there is still room for improvement in the patterns now in the market.

The Human Element in Gas-Works.

While great and ever-growing attention is being given to the plant and machinery of gas-works, it must not be forgotten that the results obtained depend very much on the skill and behaviour of the men who direct and control operations. It may therefore be asked: Is sufficient interest being taken in the human element of a gas-works? The great American constitution states that "All men are free and equal;" and we do not wish to traverse this great democratic dogma. It must not, however, be applied to men in their capacity as craftsmen and labourers. There is the difference of natural ability, and also that of training and experience; while, on the other hand, there is the willing spirit and the "labour saving" (his own labour) disposition. It is strongly urged that, in regard to these matters, there is a field that is well worth cultivation. In the first place, it is truly said that "the boy is the father of the man," and therefore the training of the boy in technical knowledge and discipline calls for immediate attention. It would be easy

* This process is referred to elsewhere in this issue of the "Journal" (see p. 783).

† This meter was described and illustrated in a paper prepared by the inventor—illustrated extracts from which were given in the "Journal" for Jan. 21, 1913, p. 186.

here to enter into a discussion of the important and extensive subjects of general education and social economy; but we must concentrate on our own industry.

Value of Early Training.

The boy who leaves school at the age of 14 or 15 years and enters a department of a gas undertaking requires, and will repay, all the care and attention that may be given him. It is not sufficient that he is made the drudge of the shop, to fetch and carry, to boil cans, cook kippers, and wheel a handcart. It is not fair that he should be made the gas-fitter's labourer and be given such crumbs of training as may be thrown to him. Under such circumstances the natural desire to learn is checked, and indifference, or worse, takes its place.

The ideal is found in the pre-apprentice technical school, which teaches the young craftsman to handle tools and become acquainted with the elementary principles of the trade; so that he can then go into a shop or on to a job and begin to practise his handicraft. Failing this course, or indeed in addition to it, each undertaking should have a training shop on the lines of the Gas Light and Coke Company's scheme, as described in Mr. Goodenough's paper to the Institution last year, modified to suit each individual case. It is gratifying to know that the Board of Education are giving the matter of technical training schools special attention, and that the City and Guilds of London Institute have arranged for gas-fitters' classes to be started in the autumn of this year.

As far as the operations of undertakings are concerned, this work should be initiated and supported. Personal interest should be shown in the work of the boys, and every encouragement given to make each a "workman who needeth not to be ashamed." The desire to work is instinctive in the normal character, and is demonstrated in the very play of childhood. The desire to make things is a spark from the Divine fire. We have read of the "Curse of Labour. But in itself labour is a blessing. It has sometimes been made a curse by the harsh and inhuman conditions imposed by tyranny and selfishness; but no such reflection can be made upon our industry, and is only met with in exceptional cases elsewhere.

Recreation and Comfort for Workers.

Mr. R. L. Stevenson has written "Industry is in itself, and when properly chosen, delightful and profitable to the worker; and when your toil has been a pleasure, you have not earned money merely, but money, health, delight, and moral profit, all in one." The increasing use of labour-saving appliances has made work less toilsome; and a reduction in hours of service has not only lessened physical strain, but provided more time for rest and recreation. In regard to the latter, it is pleasing to know that in many undertakings provision is made for football, cricket, bowls, and billiards; also a club room for social functions. In this way the spirit of comradeship is developed, and a keener interest taken in the work of the undertaking. All ranks in the service are thus enabled to meet on common ground, and acquire mutual consideration and respect.

Co-Partnership.

Any means by which the workmen can be interested in the success of the undertaking should be welcomed; and of these the system of co-partnership takes the first place. It would be a waste of time to enter into particulars on this occasion. The long experience of the South Metropolitan Gas Company and the short experience in Liverpool clearly demonstrate its great value to the workmen and the undertakings. It is the best solution for the labour problem, and makes for "solidarity" wherever it is adopted.

Old-Age Pensions.

In many undertakings consideration has been given to the question of pensions for aged or infirm servants, without contribution. During the past 25 years, the Liverpool Gas Company have made the closing days of their old servants bright by payments varying from 7s. to 10s. per week, in recognition of continuous service during periods of from 20 to 35 years. Advantage has been taken of the Government old-age pensions, so that in the case of persons over 70 years of age a total of 13s. per week could be realized. A system of superannuation is also in operation in the case of salaried servants, which is greatly appreciated. The effect of these arrangements is to relieve anxiety as to the future years of infirmity and old age, and to strengthen the bond of common interest that unites the management and the men.

Remuneration of Labour.

In addition to the training of workmen, the conditions of employment, and the auxiliary means to be used for betterment, attention must be given to the question of wages. The rates of wages paid on gas-works should be fixed with due regard to the standard rates of the district. It is the duty of a public utility to pay quite as much for the various classes of work as that given by other employers in the same district for similar work. The wages earned by the gas-worker should certainly not be less than the outside man; but, on the other hand, they ought not to be much in excess. It must be remembered that the outside man represents a large proportion of the gas consumers, and that the price of gas is affected by the rate of wages. It would not be fair to increase the burden on the outside worker by high rates paid to gas-workers.

In recent years there has been considerable advance in the wages paid to all branches of labour; and there is no doubt that, among other industries, the business of gas undertakings has been thereby increased. But the movement should be uniform, and any attempt to force-up the wages of gas-workers would be injurious to the common weal.

The question of wages will be always in season. The desire for more money on the part of the workmen is common to all men, and applications should be carefully and reasonably considered. Much depends upon the spirit in which both sides approach the question; and it is here that the benefit of friendly relationship between the officials and the workmen is realized. Their association on the football field, in the social club, or at the guild meetings has begotten confidence and sweet reasonableness; so that a satisfactory result can be arrived at.

In addition to a fair wage, provision should be made for holidays with pay for all permanent servants. One week during the summer and the Bank Holidays, with Christmas Day and Good Friday (or an equivalent) are reasonable privileges which greatly benefit the workmen and result in better service being rendered.

In concluding my remarks on this important subject, I desire to state that during my long connection with the tradesmen and labourers who have been my fellow workers, I have learned to respect and admire very many of them. They have the faults and failings that are common to humanity, but not more so than men of other classes. They will respond to fair and generous treatment by giving fair and generous service; but suspicion breeds suspicion, and scanty reward leads to scanty service. "With whatsoever measure ye mete, it shall be measured to you again" is as applicable to-day as when the words were spoken.

Recent Legislation.

A review of the past year should include a reference to recent legislation, by which it is now certain that the industry will be relieved from the obligation in regard to illuminating power. The adoption of a calorific power standard will insure the supply of gas best suited to the requirements of the public, and which can be manufactured at a minimum cost. This wise course will make the way easier to establish a uniform quality of gas for the whole country, and lead to the manufacture of standardized gas appliances of maximum efficiencies. It also enlarges the field of coal supplies, with consequently a cheaper market, and renders it possible for undertakings to have a greater selection of carbonizing systems with a view to reduced costs of working. The flat-flame consumer will, of course, receive less consideration than in former years; but, with very few exceptions, he can adopt incandescent burners with enormous advantage to himself. The application of the policy to the gas industry of "the greatest good for the greatest number" is not only justified, but demanded in the interests of the public.

Harmony in the Industry.

I cannot close this already lengthy address without referring to the harmonious relations that exist between the three great branches of the industry spoken of as the "Institution," the "Industries," and the "Association." While each organ-

ization has its own peculiar interests, they are dependent upon each other for growth and development. The gasmaker needs the best appliances to extend his business of lighting and heating by means of gas; the gas-stove maker needs the most suitable and cheapest gas to extend his sales; and both need the help of the British Commercial Gas Association to give publicity to the merits of the gas and its appliances.

It is most desirable therefore that a very close bond of union should unite them, and that there should be an offensive and defensive alliance. During the past year considerable attention has been given to the question of a permanent form of union; and it was hoped that it might have been brought to a successful issue in time for a report to this meeting. It was found expedient, however, to adjourn the matter for further consideration; but it is gratifying to know that the "conversations" held between the representatives have been most friendly, and were the means of further increasing our cordial relations.

Although there is no formal and official union, we are joined in the spirit, and are prepared to take joint action when any occasion arises—as, for example, in connection with the preparation of evidence on behalf of the industry for laying before the Departmental Committee of the Local Government Board which has been appointed to inquire into the smoke nuisance.

The Institution and the District Associations.

My closing words have reference to the Institution itself, and the various organizations connected therewith. The membership was never greater in numbers, and is an evidence of its popularity in the gas industry. All the District Associations from North Britain to South Wales are in a state of robust health; and the flourishing condition of the Juniors augurs well for the future of the Institution and the industry. It has been my privilege to attend many meetings of the various bodies during my year of office; and I am able to bear testimony to the valuable work that is being accomplished. The opportunities were never greater for the gas engineer to acquire the technical and scientific knowledge requisite for the proper discharge of his duties; and it would appear that the desire to make use of them extends from the juniors to those who are drawing near to the closing period of active service. There is a most praiseworthy spirit of generosity among the members of the Institution; and it is hardly necessary to exhort them "to do good and to communicate, forget not."

The meetings of this week, by means of the various important lectures, reports, and papers, and the discussions arising therefrom, will very much benefit all of us. Also the interchange of ideas that is not confined to this hall but is carried on in season and out of season (vulgarly called "talking shop") is another valuable phase of this annual gathering.

Finally, if there is anything at the works of the Liverpool Gas Company that may be found worthy of attention, I venture to hope that your visit to this city will not have been made in vain.

APPENDIX TO MR. EDWARD ALLEN'S PRESIDENTIAL ADDRESS.

DESCRIPTION OF THE WORKS OF THE LIVERPOOL GAS COMPANY.

Since the time when the first Gas Company was established in Liverpool, in the year 1816, the growth of the manufacturing plant and distributing system has progressed steadily and without interruption to the present day.

There are now six manufacturing stations, in addition to the premises at Duke Street, where the central offices and show-rooms are situated, as well as extensive shops in which meter-making, repairing, gas-fitting, stove and fire maintenance, &c., are carried on. Of the six manufacturing stations, the oldest are the Eccles Street works, which replaced the original works in Dale Street and the Athol Street works erected by the Oil Gas Company in succession to the works at Rose Hill. Both are situated on the Leeds and Liverpool Canal, by means of which coal is received from the Wigan coalfield.

Considerable alterations have been made from time to time to these works; but the retort-houses and main buildings remain for the most part as they were originally built about 1830, and are in a good state of preservation, notwithstanding that they have attained an age of about eighty years.

The next works to be erected were the Caryl Street works, in 1847—then known as the Harrington Street works, in the south end. These works are now the smallest in capacity, and are mainly of importance as a distributing station.

In 1856, new works were erected at Wavertree, in the east of the city. They were considered model works at the time when they were built, and were described and illustrated in "King's Treatise." The Wavertree works have, in recent years, been largely adapted to modern methods; but the general arrangement and original buildings remain a monument to the memory of the Engineer who designed them—the late Mr. Alfred King, M.Inst.C.E.

The fifth gas-works to be erected were those at Linacre, about a mile beyond the northern boundary of the City of Liverpool, and situated within the Borough of Bootle. The original works date from 1867, and were of 1½ million cubic feet per day capacity. They have been added to and remodelled from time to time, and will shortly have a daily capacity of 18 million cubic feet, with a possible extension in the future, by means of additions to the carburetted water-gas plant, to 22 millions. They are by far the largest works of the Company, and are responsible for more than half the total output of gas at the present time.

The last entirely new works to be laid down were those at Garston, at the extreme south end of the city, in 1894. The plant at Garston so far is entirely for the manufacture of carburetted water gas. But an area of land, 32½ acres in extent, has been secured here, sufficient to meet future requirements for many years. A large unit of coal-gas plant is in contemplation. At present the Garston works are probably unique in this country and in Europe, as being a station where carburetted water gas only is made. The present capacity is about 4 million cubic feet per day; but provision is made for doubling the output.

The steady growth of the manufacturing plant during 49 years (the period during which the President has been connected with the Company) may be seen from the following table:—

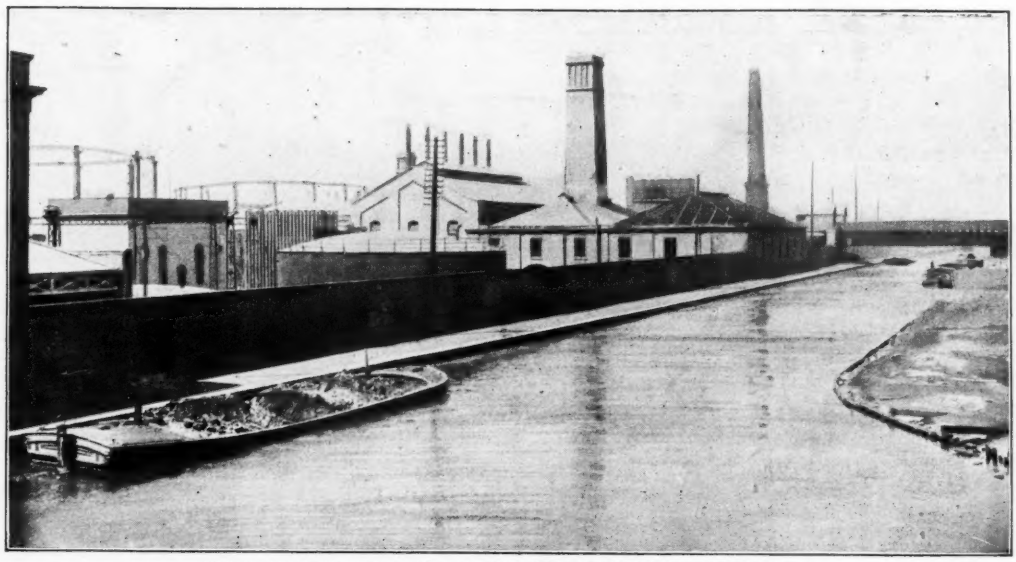
Year.	Number of Works.	Area of Works. (Acres.)	Capacity of Works. (Millions per Day.)	Annual Make. (Millions.)
1865 . . .	4	24	7	1250
1874 . . .	5	49	11	1867
1884 . . .	5	56	16	2745
1894 . . .	5	77	18	3367
1904 . . .	6	79	22	4003
1914 . . .	6	79	28	5326

It will be seen from the table that there has been during the last decade an increase in the manufacturing capacity of 27 per cent. This increase has been obtained almost entirely by replacing obsolete plant by modern installations of greater capacity.

Intercommunication.

The six works are connected together by high-pressure mains, which in recent years have been invaluable in keeping up the supply during the periods of heaviest demand. By this means the deficiency at one works is easily met by a supply from the other works. Large exhausters are installed at Linacre and Garston for pumping the gas north and south as required. Between the Garston works and the Caryl Street works there are two connecting mains—one being used for conveying coal gas to Garston, to be mixed with an equal quantity of carburetted water gas; while the other is used for supplementing the supply of coal gas manufactured at Caryl Street and at Wavertree by means of the mixture from Garston. The connecting or "messenger" mains vary from 20 inches to 36 inches in diameter, and are approximately 18 miles in extent.

It may here be said that the general policy has been to develop to the full extent the existing works of the Com-



VIEW OF THE LINACRE GAS-WORKS FROM THE SOUTH-EAST.

pany; to adopt modern labour-saving appliances, wherever possible; and to enlarge and extend the existing purifying plant where increased capacity and new conditions have rendered it necessary. At all the works, with the exception of Caryl Street, the retort-houses have been remodelled and machinery installed, with the result that the cost of working has been reduced, while the output has been increased.

Linacre Works.

The Linacre works (the largest of the Company's stations) comprises three complete coal gas plants—viz.:

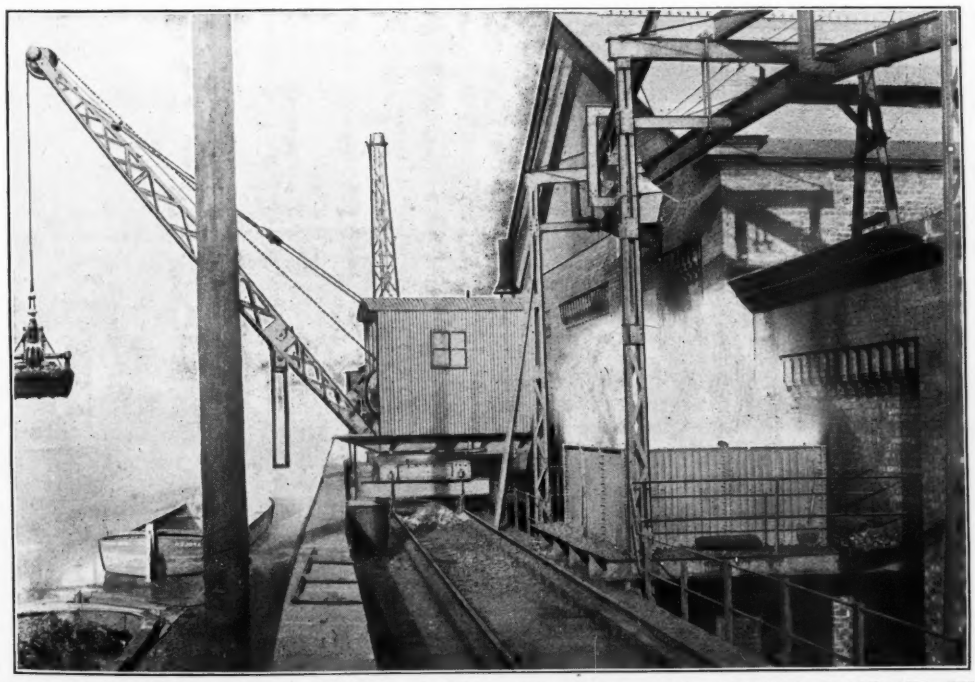
The north works of 3 million cubic feet daily capacity.
The south works, of 8 million cubic feet daily capacity.
The experimental works, of 160,000 cubic feet capacity; also carburetted water gas plant having a daily capacity of 7 million cubic feet.

Coal Delivery.—There are two methods of receiving and discharging the coal. At the north works the coal is brought in by a high-level railway, and discharged by gravity through bottom doors to the shoots leading to the coal-breakers, or to the coal stores situated immediately beneath the overhead railway. The railway is a branch of the Midland line running to Alexandra Dock Station.

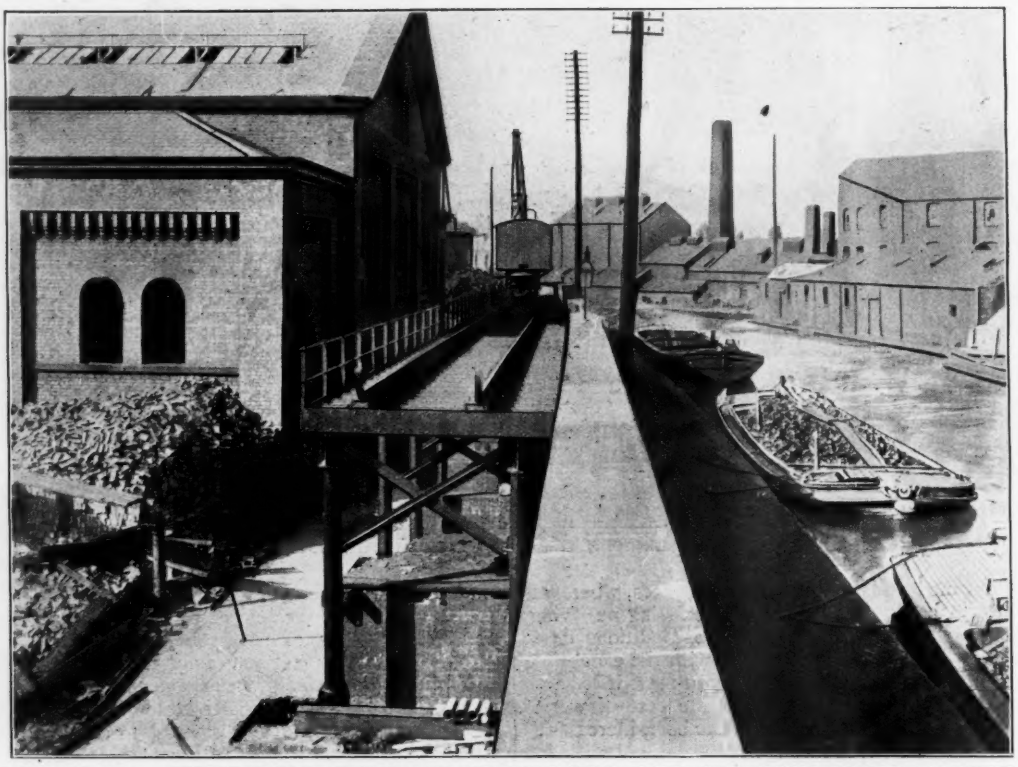
The other method of receiving our coal at Linacre is by the Leeds and Liverpool Canal, which bounds the works on the east and south sides. The barges, holding from 50 to 80 tons of coal, are discharged by steam-jib travelling cranes and Priestman single-chain grabs of 15 cwt. capacity. Three of these very efficient and reliable machines are now at work, running on an elevated craneway; and a fourth crane is on order. Each crane is capable of dealing with 16 tons of coal per hour, and discharges into an Avery automatic weigher, fixed over the top of the coal-breaker.

Coal Weighing.—There are three of these machines, each of one ton capacity, now at Linacre. They weigh and record the weight of all coal passed through. Each weighing operation occupies about 30 seconds. The bottom door of the weigher is then automatically opened, allowing the contents to be discharged into the breaker below, after which the door closes, and the machine is ready for another grab full. The weighing mechanism is operated by a small electric motor of $\frac{1}{2}$ B.H.P. One of the machines has weighed 312,000 tons of coal without any repairs. Coal received by rail is weighed with the trucks on platform machines in the ordinary way.

Coal Breaking and Handling Plant.—The north plant is provided with two coal-breakers, each of 30 tons per hour capacity, with two pairs of rolls to each, direct driven by two horizontal steam-engines. The coal is elevated to a small hopper above the roof of the retort-house, by means of two



THE JIB-CRANE AND GRAB FOR UNLOADING BARGES, ALSO PART OF THE TELPHER TRACK AND COKE-QUENCHING TANK AT THE LINACRE GAS-WORKS.



END OF NO. 2 RETORT-HOUSE AT THE LINACRE GAS-WORKS, WITH THE CRANE ON THE ELEVATED CAUSEWAY FOR DISCHARGING COAL FROM BARGES.

12-inch bucket elevators, and is conveyed to two large coal-bunkers—one for the west retort-house and one for the middle retort-house—by means of a band conveyor.

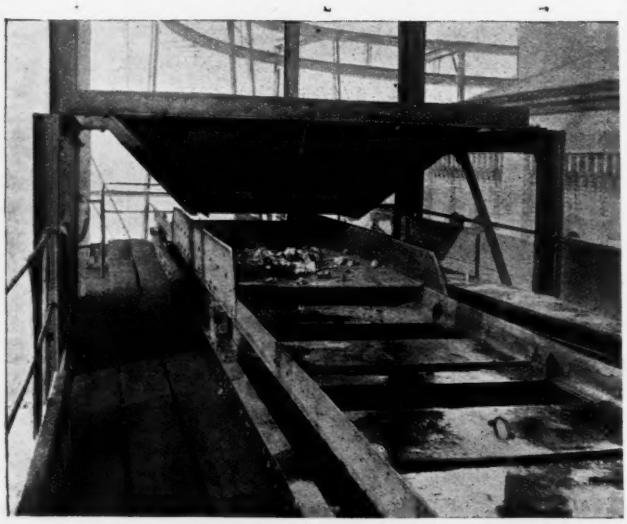
The Arrol-Foulis stoking machines run under the coal-bunkers, and are fed with 5 tons of coal each time through shoots from the bottom of the coal-bunkers. The whole of the coal plant was supplied and erected by Sir William Arrol and Co., Limited, and the Chain Belt Engineering Company, of Derby.

At the south works, the coal plant for the vertical-retort installation will, when it is completed, consist of two coal-breakers, each having four rolls and a capacity of 30 tons per hour; the two breakers being driven by a 27 B.H.P. Crossley gas-engine. Each breaker will deliver into a gravity bucket conveyor by means of a shoot and rotary filler. The two conveyors will carry the coal up to the end of the first bench, elevate it to the roof of the building, and convey it along the full length of two lines of coal-bunkers over the first bench and to the single gravity bucket conveyor feeding the two lines of coal-bunkers of the second bench.

Shoots will be provided so that either of the first conveyors can be used for filling either of the two lines of bunkers over the first bench. Provision will also be made for either of the first conveyors feeding the single conveyor over the second bench, by means of shoots and rotary fillers. This arrangement is designed to deal with the day's supply of 400 tons of coal comfortably in two eight-hour shifts. The capacity of the coal-bunkers is equal to the requirements of forty-eight hours.

For supplying the north vertical bench during the construction of the south bench, a cross-conveyor has been fixed near the centre of the house, passing under the floor of the retort-house, where it is fed from a hopper through a rotary filler, and, running up the end of the bench, delivering into the longitudinal conveyor at the top. This cross-conveyor is only fixed temporarily, and will eventually form part of one of the main conveyors already described. When the scheme is completed, the present disadvantage of having to wheel the material to the filler at the centre of the house will be removed. The conveyors throughout are driven by electric motors.

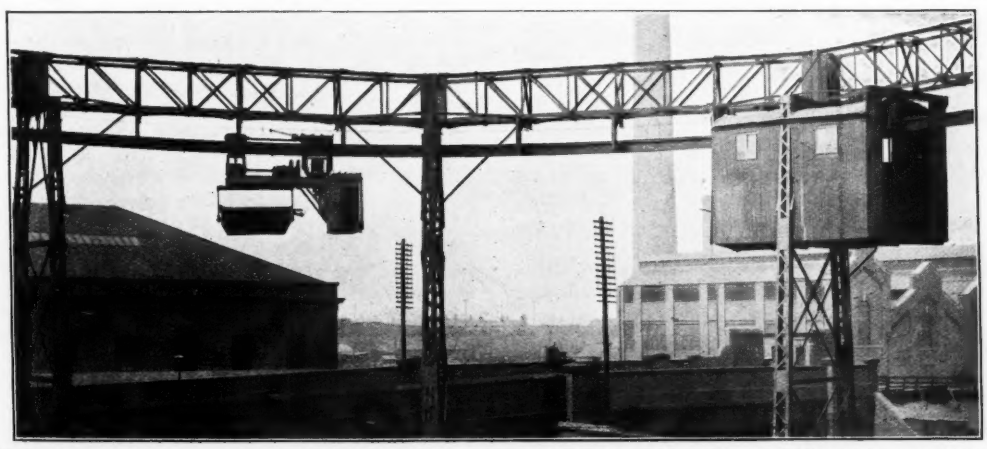
The coal plant for the No. 2 retort-house, south works, consists of a double breaker of 40 tons per hour capacity, driven by a 20 B.H.P. motor. The coal is fed into the main breaker by a jigger screen, under which is fixed a bye-pass shoot, through which the small coal passes direct to the boot of the elevator. The larger coal, after being broken by the two pairs of rolls in the main breaker, falls on a second jigging screen, under which a bye-pass shoot is fixed, carrying the small broken coal to the elevator; while the larger coal rejected by the screen is passed to the secondary breaker. The latter is provided with two pairs of rolls with finer teeth—reducing the coal to a size about 1-inch cube.



Vibrating Screening Conveyor at the Linacre (South) Gas-Works.

The whole of the plant was specially designed to break the coal and hard cannel to a suitable size for the Fiddes-Aldridge machines, and was supplied and erected by Messrs. Drakes Limited. The coal is elevated by an 18-inch bucket elevator and conveyed about half the length of the retort-house by a 24-inch push-plate conveyor. Sliding doors are fixed at frequent intervals in the bottom of the conveyor for filling the continuous coal-bunkers, which have a capacity equal to forty-eight hours' supply. The end of the push-plate conveyor near the middle of the house is arranged to deliver on to a tipping-tray conveyor, which carries the coal over the bunkers in the other half of the house. Two portable dumpers, running on angle rails, are provided for filling the bunkers at any point. This conveyor was installed by Babcock and Wilcox, Limited. The whole of the elevating and conveying machinery is driven

VIEW (TAKEN MAY 14) OF THE COKE TELPHER AT THE END OF THE RETORT-HOUSE—GLOVER-WEST VERTICAL RETORT INSTALLATION—AT LINACRE.



VIEW (TAKEN MAY 28) OF THE COAL TELPHER IN CONNECTION WITH THE GLOVER-WEST VERTICAL RETORT INSTALLATION AT LINACRE.

by electric motors. The plant is capable of dealing with one day's supply (260 tons) in one shift of eight hours if necessary; but it is found more convenient to extend the work over two shifts.

As a stand-by, an old breaker and elevator, driven by a steam-engine, formerly used with an Arrol-Foulis installation, has been fixed near the middle of the house. When this plant is used, it is more convenient to take the coal from stock, and it is necessary to reverse the direction of the first push-plate conveyor so that the coal may be taken from the middle of the house towards the end. It has been found useful as a stand-by and auxiliary on several occasions.

Carbonizing Plant.—At Linacre there are four systems of carbonizing now in use—viz: (1) Horizontal retorts hand-charged [these have not been used for some years now]; (2) horizontals charged by Arrol-Foulis machinery and discharged by Williams and M'Phee pushers; (3) horizontals charged and discharged by Fiddes-Aldridge machinery; (4) Glover-West vertical retorts. Until recently a fifth system was in operation—viz: inclined retorts; but these have been removed in favour of a second installation of verticals. [For particulars regarding the various installations, see next page.]

Coke-Handling Plant.—The coke from the west and middle retort-houses of the north works is pushed from the retorts by Williams and M'Phee pushers into steel skips, placed on loose carriages, each provided with two wheels. The skip, filled with red-hot coke, is wheeled by hand into a quenching chamber, provided with a wooden ventilating shaft at the top for carrying away the steam.

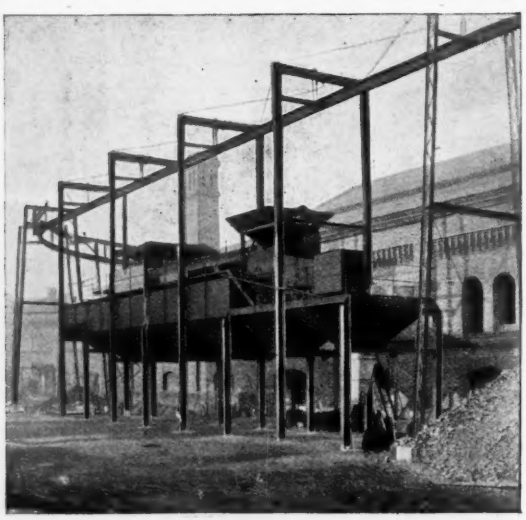
Carbonizing Plant, Linacre Gas-Works.

Works.	Retort. House.	Bench.	Date of Erection.	Description.	No. of Beds.	Retorts per Bed.	Total No. of Retorts.	Size of Retorts.			Coal per Charge Cwts.	Duration of Charge.	Coal per Day.	Gas Made per Day at 12,300.
								Width.	Depth.	Length.				
								Inches.	Inches.	Ft. In.	Average.	Hours.	Tons.	
North	West	G	1906	Horizontals with	7	6	42	22	16	18 0	12	12	100	1,230
		H	1906	Arrol-Foulis and	7	6	42	22	16	18 0	12	12		
North	Middle	I	1908	Williams and	6	6	36	22	16	18 0	12	12	86	1,058
		J	1908	M'Phee Machines	6	6	36	22	16	18 0	12	12		
North	East	K	1894	Horizontals	7	6	42	22	12⅞	18 0	3·65	4	92	1,132*
		L	1894	hand-charged	7	6	42	and 15½						
							240						278	3,420
South	No. 1	M	1914	Glover-West	8	8	64				continuous		200	2,460
		N	1914	Verticals	8	8	64				continuous		200	2,460
	No. 2	P	1909	Horizontals	8	6	48	23	16	20 0	10	8	144	1,771
		Q	1909	and	8	6	48	23	16	20 0	10	8		
		R	1908	Fiddes-Aldridge	5	6	30	23	16	20 0	10	8	117	1,439
		S	1908	Machines	8	6	48	23	16	20 0	10	8		
							302						661	8,130
Experiment		North		Hand-charged	2	6	12	22	16	10 0	2·33	4	16·8	207
		South		single-ended	2	6	12	22	16	10 0	2·33	4		
							24							

* Direct Fired. Not been used for some years.

A flushing cistern, of 70 gallons capacity, fitted with an adjustable syphon for regulating the quantity of water required, and operated by a lever and chain, is fixed above the quenching chamber. On pulling the chain, a measured quantity of water descends down a pipe into a shallow quenching tank perforated with fine holes in the bottom, through which a shower of water falls on to the coke in the skip. After the water has ceased to flow, the skip is wheeled from the quenching chamber to a Temperley transporter, and hooked on to the travelling fall block. It is then lifted up from the skip-carriage and transported to the coke-store or carburetted water-gas plant.

The beam of the transporter has a total working length of 370 feet. It extends the full length of the west retort-house, about 6 feet away from the discharging side of the benches,



Telpher Track and Coke-Breaking and Screening Plant at the Linacre Gas-Works.

and has a gradual rise of 1 in 8, reaching a maximum height of 67 feet from the ground at the far end, where are provided a hopper and shoots, into which the skips automatically discharge for feeding the carburetted water-gas generator house. At an intermediate point the transporter passes over the Midland branch high-level sidings, and may be used for transporting the coke from the retort-house directly into waggons. It may also be used for the greater part of its length for placing the coke on the stock heaps. All the operations of lifting, lowering, travelling, and tipping are controlled by one man in a small winch-house at one end of the retort-house. The winch is driven by a 20 B.H.P. Siemens totally enclosed series-wound electric motor.

In the west retort-house an alternative method of handling and cooling the coke is provided, known as the "Dryco" process, by which the coke is cooled in a closed vessel without any water whatsoever coming into contact with it. The coke is pushed from the retort directly into a steel container, consisting of two parallel vessels fastened together one above the other, of the same section as the retort and half its length. The container is placed in line with the retort in a horizontal position, and after one half of the charge has been pushed into the top compartment the container is raised and the other half is similarly filled. The container is then turned into a vertical position on trunnions, and a lid, suspended from the bridle, automatically closes the open end of the container. It is then transported and lowered into a special form of water-tank with provision for cooling six containers at the same time. Water is circulated round the containers by means of a Tangye pump.

In three-quarters of an hour to an hour the coke is cooled. The container is then lifted by the transporter and automatically discharged. In the interval between placing one container in the tank and its removal to the coke-store, the transporter deals with several other containers in the same way. As the vessel is closed and water-tight, neither water nor air has access to it during the period of cooling, with the result that the coke is absolutely dry, and of a bright silvery colour. It is, moreover, large and free from breeze, as breakage is avoided almost entirely. Dryco is much superior to ordinary gas coke. Customers who have used it speak highly of its value as a fuel, and are prepared to pay more for it.

At the south works, both the vertical and horizontal installations have been provided with telpher coke-handling plant.* Particulars of these are given in the following table:—

	Verticals.	Horizontals.
Maximum span of girders	46 ft. 8 in.	22 ft.
Length of track	765 ,,	796 ,,
Height of track	52 ,,	35 ,,
Minimum radius	25 ,,	17 ,,
B.H.P. lifting motor	15	11
B.H.P. travelling motor	6	7
Capacity of skip, cwt.	20	16
Speed of lifting (feet per minute)	70	60
Speed of travelling (feet per minute)	500	500

In the horizontal retort installation the track is an endless one, and runs through the retort-house in front of the benches. The coke is pushed from the retorts into skips of the open self-tipping type, and is carried to either of two elevated quenching tanks situated outside each end of the retort-house. The skip is lowered into the tank until the bottom is a few inches below the surface of the water. There is generated a large volume of steam, which rises up through the coke and assists in quenching it.

Improvements have been effected in this method of quenching by fitting a pair of doors to the top of the tank.

* An illustrated article dealing with this telpher plant appears on p. 784 of this issue of the "JOURNAL."—ED. J.G.L.

The doors are automatically closed by the descending skip as it is lowered within the tank. The steam generated is thus largely confined within the tank and around the skip full of hot coke. In addition to this, perforated water-pipes are arranged within the tank near the top, through which sprays of water play upon the upper surface. The skip, after treatment in this way for thirty seconds, is raised, transported, and dumped either into the receiving hopper of a coke screening and conveying plant, which is fixed over a range of coke bunkers, or on the stock heap. The screens, of Bentley vibrating type, take out all the small and dust below ½-inch cube, and convey the large coke to the four bunkers, which are fitted with doors at the bottom, operated by chain wheel and screw gear, for filling motor waggons and carts.

One of Cort's 20-ton per hour coke breakers also forms part of this installation, provided with Bentley screens for sorting the coke to different sizes. A tipping tray conveyor carries the broken coke to a further range of bunkers, of 90 tons capacity, from which the broken coke is delivered into carts or bags.

The track of the telpher for the vertical installation will, when completed, be an endless one, running inside the house, along one side of the vertical-retort benches and over the coke yard outside, triangular in shape.

The skip are of two different patterns, both of 20-cwt. capacity—viz., (*a*) self-tipping, and (*b*) bottom-opening. It is too early to say which of these will prove to be the more satisfactory. It is evident, however, that the bottom opening skip will allow of the skip being discharged with a minimum of fall or breakage. The skips are placed on loose carriages running on rails let into the retort-house floor and extending underneath the benches; one carriage and set of rails being provided for every four retorts.

The skip after being filled with coke, which has already been cooled within the lower portion of the retort and coke extracting chamber, is wheeled under the telpher track, picked up, and transported either to the coke bunkers, the stock heap, or the hopper for feeding the producers. A light railway is fixed over the top of the producers, extending at one end under the coke-feeding hopper and at the other end to the electric hoist, on which the coke-bogie runs for feeding the producers. The hoist is available as a stand-by in case anything goes wrong with the telpher.

The coke-bunkers are of 100 tons capacity, and were formerly coal-bunkers in connection with the old installation of inclined retorts. On the top of these bunkers will be fixed a receiving hopper, coke-breaker of 24 tons per hour capacity, bye-pass shoot, and Zimmer screening conveyor capable of dealing with 10 cwt. of coke per minute. By this arrangement any of the hoppers may be filled with broken or unbroken coke as desired.

Pan Ash Separation.—A "Nota Nos" pan-ash washer has been fixed in connection with the horizontal installation at the south works. Skips, specially constructed for the purpose, are placed on loose carriages which run on a light railway the full length of the cellar. The skip, after being charged with pan ash direct from the furnace, is wheeled along the railway to an opening in the floor, through which the skip is hoisted by the telpher, transported along the telpher track, and dumped into a 7-ton receiving hopper feeding the pan-ash washer. The latter is provided with an automatic feeding arrangement, a screen to take out the fine dust, and an ample water supply from an electrically driven centrifugal pump in the cellar of the retort-house. The washer has a maximum capacity of 5 tons per hour, and is sufficiently large to deal with the whole of the production, including that from the carburetted water-gas plant.

Carburetted Water-Gas Plant.—This plant is situated in a central position on the works, in an old retort-house, 105 feet long by 54 feet wide, extended upwards and adapted for the purpose. The whole of the generating plant was supplied and erected by Messrs. Humphreys and Glasgow, of London, and was recently remodelled by the firm. The capacities of the sets were thereby increased considerably, and are now as follows:—

Number of Sets.	Original Capacity Per Day.	Present Capacity per Day.	Combined Capacities per Day.	Diameter of Generator.
	Millions.	Millions.	Millions.	Ft. in.
4	·8	1·5	6·0	9 6
2	·5	0·9	1·8	8 6
6			7·8	

Steam is provided at 120 lbs. per square inch pressure by five Babcock and Wilcox boilers, each having a heating surface of 1827 square feet.

The air-blast is produced by three No. 10 Sturtevant blowers, driven by belts from Bellis and Morcom high-speed engines. On each set a dust interceptor is fixed, between the generator and the carburettor, for catching the dust and ashes and preventing them from entering the fixing chambers—thus avoiding nuisance, and increasing the efficiency and life of the checkerwork. Each set is also fitted with safety valve-interlocking gear, air-blast and steam meters, and electrical pyrometers.

At one end of the operating floor two coke-shoots are fixed to a large coke-hopper outside, passing through the wall and fitted with sliding doors operated by chain wheel and screw, from which the coke-bogies for feeding the generators are filled. The coke is transported direct from the retort-house to the carburetted water-gas plant, as already described.

One of the smaller generators has just been fitted with a new form of mechanical grate by Messrs. Humphreys and Glasgow. By this means the laborious work and discomfort of clinkering the generators by hand is entirely obviated. The grate is operated by a small hydraulic motor.

There are three primary condensers of the vertical water-tube type; the gas passing in at the top and around the tubes, while the cold water enters at the bottom and passes upwards through the tubes. The condensers are provided with valves and connections for working either in series or in parallel.

Oil Storage.—There are two steel tanks for storing the oil required at Linacre. These are situated within brick moats alongside the canal, and are filled from barges, which convey the oil from the larger tanks at Garston. The particulars of the Linacre tanks are as follows:—

Tank.	Diameter.	Depth.	Capacity.	Capacity.
	Feet.	Ft. In.	Gallons.	Tons.
No. 1 . . .	60	25 0	442,000	1700
No. 2 . . .	78	28 6	800,000	3000

Condensation.—The type of condenser used at Linacre throughout, with the exception of the primary condensers of the carburetted water-gas plant, is the cast-iron vertical pipe condenser. The erection of a water-cooled condenser, to make up the deficiency due to the increased output at the south works, is now in contemplation. General particulars of the condensers in use in the different sections of the works are given in the following table:—

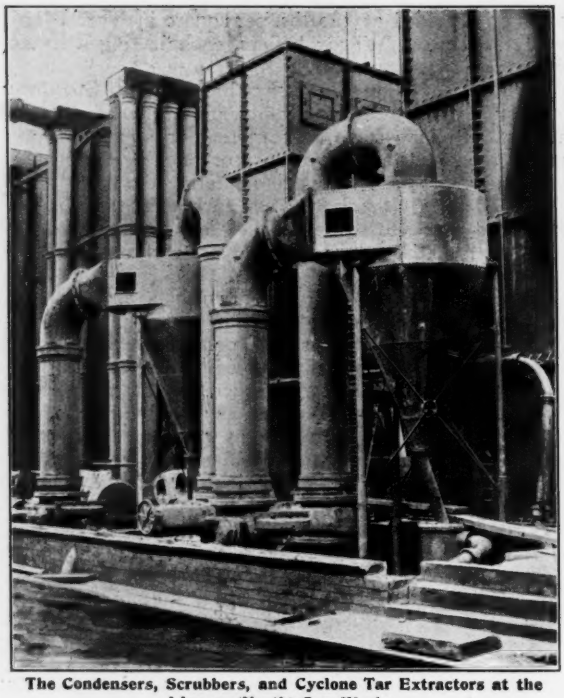
Works.	Nominal Capacity of Works per Day.	Pipes in Each Set.		Total Height.	No. of Sets.	Length.	Width.
		No.	Bore.				
	Millions.		In.	Ft. In.		Ft. In.	Ft. In.
North . .	3½	44	12	30 3½	6	37 1	3 2
South . .	8	56	12	30 3	8	47 10	3 2
C.W.G. .	7	20	12	30 6	5	31 2	5 0
		44	12	30 3½	2	37 1	3 2

Exhausters.—The exhausters are all of the "Beale" two-blade type, with the exception of the two recently installed in the machinery house of the carburetted water-gas plant, which are of the four-blade type. All the exhausters are driven by horizontal steam-engines. Particulars of the exhausters are given below:—

No.	Capacity per Hour.	Make.	No. of Engines.	Purpose.	Remarks.
	Cub. Ft.				
3	200,000	Donkin	3	North coal-gas plant	4 blade
1	160,000	W. H. Allen	1	South coal-gas plant	
2	110,000	,,	2	South coal-gas plant	
2	120,000	Donkin	1	C. W. gas plant	
2	100,000	,,	1		
2	80,000	,,	1		
8	63,000	Gwynne	4	Pumping to other works	

Tar Extractors.—At the north works, the gas, after leaving the condensers, passes through a pair of "Cyclone" tar-extractors, which remove the remaining tar not thrown down in the condensers. In the south works, three Livesey washers are used—one of 3 millions capacity and the others of 2 millions capacity each.

In the carburetted water-gas works, the fine tarry vapour which is always so difficult to entirely remove, is dealt with in three stages. Immediately after the condensers, the gas is passed through a pair of filter boxes, 10 feet square, which are filled with layers of broken clinker, carefully



The Condensers, Scrubbers, and Cyclone Tar Extractors at the Linacre (North) Gas-Works.

screened to different sizes; the gas flowing through a coarse layer first, and finishing with the finest layer. These filter boxes are very efficient in removing the bulk of the tar, but will not remove the last traces.

The gas, after leaving the exhausters, is taken through two Pelouze and Audouin tar-extractors, by which much of the fine tarry vapour is removed. It is finally passed through three of Carter's patent tar-extractors, which are fixed in the inlet pipes of the oxide purifiers.

Scrubbers and Washers.—In the north works, there are six scrubbers, 8 feet square by 24 feet high, filled with wooden boards, and provided with the usual water and liquor distributing arrangements at the top. At the south works, there are no scrubbers. The liquid purification is effected by Livesey, "Standard," and centrifugal washers. Particulars are given below of the mechanical washers in use:

Works.	No.	Capacity of each per Day.	Type.	Purpose.	Remarks.
North	2	1½ millions	"Standard" washer scrubbers	Ammonia, &c., extraction	
South	1	3 ,,	"Standard" centrifugal	Cyanide and ammonia extraction	(*a*)
South	1	3 ,,	"Standard" washer scrubber		
South	2	2 ,,	"Standard" washer scrubber	Ammonia, &c., extraction	(*a*)

The "Standard" centrifugal washer is to be used experimentally for cyanide extraction. The three "Standard" washer-scrubbers (*a*) have been fitted throughout in recent years with Holmes' brushes.

Purifiers.—The older purifiers are of the water-lute type, enclosed in substantial brick buildings and fixed above ground, with revivifying floors beneath. The more recent additions are of Green's rubber-jointed type, fixed above the ground with floor beneath, and covered with steel roofing supported by steel stanchions; the sides of the building being quite open. Provision is made for elevating and conveying the purifying materials by means of gravity-bucket conveyors. Particulars are given of the purifiers now in use.

Station Meters.—The station meters are of the usual type, made by the Gas Meter Company, Oldham, with but two exceptions. A "Rotary" meter has been installed in the south works for dealing with the increased make of gas due to the adoption of vertical retorts. The increased output of carburetted water gas has necessitated an additional meter in this section of the works; and a trial has been made of the "Thomas" electric meter. It is the only one working in this country at the present time, and is on an entirely new principle, which bids fair to revolutionize the present method of measuring gas.

The main advantages of the Thomas meter are that the body of the meter occupies very little more space than the pipe itself; that gas under high pressure can be measured with the same degree of accuracy as low-pressure gas; that the recording mechanism may be placed any distance away from the meter; that the results may be at once read without the necessity for correction for temperature and pressure. The principle on which the meter works may be briefly stated. If gas, in flowing through a passage, is heated through a fixed and constant temperature range by means of a heater in the passage, the specific heat of the gas being constant, the quantity of heat thus introduced is a measure of the gas flowing. This heat is introduced by means of an electric heating unit fixed across the passage. The electric energy supplied to it is measured by a watt-meter which is calibrated to read directly in cubic feet of gas instead of electrical units.

By means of electric thermometers before and after the heater the quantity of electric energy applied is so regulated that the difference in temperature of the gas between the inlet and outlet of the meter is automatically kept constant. The two thermometers are connected with a galvanometer, the needle of which is balanced in a central position when the two thermometers are of equal resistance. When there is a difference in temperature the needle is deflected to the right or left; and the deflections are utilized to operate the rheostat regulating the heater.

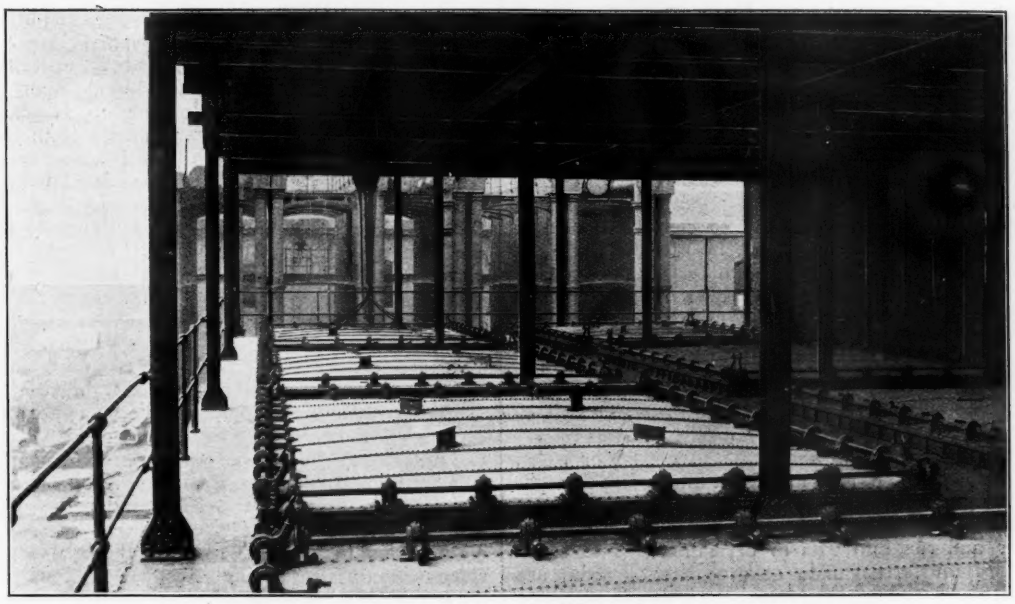
Power for operating the rheostat is supplied by a small motor running continuously at constant speed. By an ingenious arrangement of gearing and pawls operated by magnets, which are energized more or less according to the position of the galvanometer needle, the rheostat controlling the heater is automatically regulated; so that the temperature rise in the gas is always constant as the rate of flow of gas varies from time to time. A series of tests has been made at Linacre, comparing the measurement of gas recorded by the Thomas meter with the readings of a large station meter of the ordinary type (the same gas passing through both), with very encouraging results.

Trouble was experienced at first on account of the moisture in the gas collecting on the electrical connections causing short-circuits; but special provision has been made to overcome this difficulty. Since the improvements have been made there has not been sufficient time to carry out exhaustive tests on which a definite opinion can be expressed; but there is every reason to believe that the meter will be a useful and reliable instrument. The "Thomas" meter at Linacre is capable of passing 750,000 cubic feet of gas per hour; while the capacity of the ordinary station meter alongside of it, occupying seven times the space, is only 175,000 cubic feet per hour.

Electrical Plant.—The whole of the coal breaking, conveying, and stoking machinery in connection with the Fiddes-Aldridge installation and the vertical benches at the south works, the three coke-handling plants, the pan-ash washer and centrifugal pump, the oxide conveyor, and the electric meter are electrically driven by direct current at 220 volts generated on the works. The power house is 86 feet long by 20 feet wide, and contains three dynamos of 40½ K.W. capacity directly coupled by Zodel-Voith flexible couplings

Oxide or Lime.	Works.	No.	Description.	Size.			Valves.	Lifting Apparatus.	Direction of Flow.
				Length.	Width.	Depth.			
				ft. in.	ft. in.	ft. in.			
Lime	North	2	Water-lute	43 0	34 0	5 6	Hyd.	Traveller	Up
Lime	North	2	Water-lute	58 0	27 0	5 6	Hyd.	Traveller	Up
Oxide	South	8	Water-lute	36 0	23 0	6 3	Hyd.	Traveller	Down (*a*)
Oxide	South	2	Water-lute	39 0	25 0	6 3	Gas valves	Fixed crab and pulleys	Up
Oxide	South	4	Green's	46 0	32 6	5 6	24-in. Weck	Pulley block	Down (*a*)
Lime	C. W. Gas	6	Water-lute	52 0	26 0	5 6	30-in. Hyd.	Traveller	Up
Oxide	C. W. Gas	2	Green's	48 0	34 6	5 6	30-in. Weck	Pulley block	Up
Oxide and Lime	Experiment	4	Green's	16 6	15 9	5 0	12-in. Hyd.	Pulley block	Up

(*a*) Fitted with Spencer's hurdle grids.



THE NEW PURIFIERS AT THE LINACRE (NORTH) GAS-WORKS.

to three 60 B.H.P. National gas-engines. A fourth set is now being installed, consisting of a 52·8 K.W. dynamo and an 80 B.H.P. Keighley gas-engine. A large cast-iron water tank, which was in use for many years for storage purposes, has been utilized for cooling the supply of water to the cylinder jackets. The switchboard consists of four dynamo and three motor panels; and the fittings include Kelvin-White voltmeters and ammeters. When the work in hand is completed, there will be 35 electric motors in use at Linacre, ranging from 20 B.H.P. down to ½ B.H.P.

Gasholders.—The gasholders throughout are all of the same pattern, with guide-framing to the full height, consisting of heavy cast-iron columns and steel lattice girders. The tanks are formed of brick and puddle. Special mention should be made of the No. 3 holder, which is provided with heavy cast-iron weights all round the circumference, resting on the bottom angle curb of the outer lift. By this means the pressure given by the holder has been increased from about 8 inches to 10 inches. The sizes and capacities of the holders are given in the following table:—

No.	No. of Lifts.	Size of Outer Lift.		Full Capacity.	Maximum Pressure.	Date of Erection.
		Diameter.	Depth.			
		Ft. In.	Feet.	Cubic Feet.		
1	2	140 2	30	859,000	47-10ths	1865
2	2	140 2	30	859,000	52-10ths	1870
3	2	152 2	30	1,007,000	96-10ths	1874
4	2	140 2	30	859,000	55-10ths	1873
5	2	165 0	30	1,176,000	62-10ths	1886
6	3	165 0	30	1,739,000	78-10ths	..
7	2	180 0	30	1,420,000	62-10ths	1881
8	2	180 0	30	1,413,000	70-10ths	1888
9	1	62 0	20	66,000	17-10ths	1898 (*a*)

(*a*) Carburetted water gas plant.

Booster.—In order to meet the heaviest demands in winter without loss of pressure, a turbo-driven booster of 600,000 cubic feet per hour capacity has recently been arranged for. The inlet to the booster will be connected to the outlet of the holders; and the booster will deliver direct to the inlet of the governors or to the heavy holder No. 3, which is connected with the governor inlet. An automatic diaphragm governor will be provided, which will open in the event of the booster failing and the heavy holder becoming uncupped; thus ensuring a supply of gas to the station governors under all conditions.

Station Governors.—There are five station governors at the north works and one at the south works, controlling the supply of gas to six different districts in North Liverpool, Bootle, and the out-townships north of Bootle. The governors are of the Liverpool pattern throughout, introduced by Mr. Alfred King at an early date in the history of the Company. The governor is simple in construction, consisting of a bell in an annular tank, with rocking beam and counterbalance weights. The cone valve of the governor is suspended from the inside of the bell, and works in a seat fixed to the top of the inlet pipe. The valve is carefully proportioned to give the correct amount of opening for the different pressures. Each governor is provided with a bye-pass valve, also fitted with a cone, carefully designed to open in exact proportion to the movement of the spindle.

In the ordinary method of working, the bulk of the gas is passed through the bye-pass valve. The governor takes the difference and controls the pressure of the whole. Thus a much smaller governor valve is required than would be the case if the whole of the gas were passed through the governor. This system of governing has been found quite satisfactory; but the constant attendance of a pressure man is necessary. The district mains leading from the governors range from 18 to 30 inches in diameter.

Naphthalene Extraction.—Until the autumn of 1913, the admixture of carburetted water gas with the coal gas was sufficient to keep the naphthalene content down within reasonable limits. Last year, however, owing to the high price of gas oil, less carburetted water gas was used, with the result that considerable naphthalene trouble was experienced on the districts served by the Linacre works. To prevent a recurrence of the trouble, a "Simplex" vaporizer is being installed in the booster-house, in which Russian vaporizing oil will be vaporized by a steam jacket. A portion of the gas made is passed through the apparatus, mixing with the bulk of the gas in the main leading to the governors and districts. This oil takes up a large quantity of naphthalene in the gas, and, on becoming saturated, is thrown down in the liquid state in the mains, where it flows to the nearest syphon and is removed in the ordinary way. Connections have also been provided for passing the vaporized oil into the inlet of the station meters and into the inlet of the gasholders for dealing with deposits at these points.

Tar and Liquor.—In the two coal-gas sections the liquid products are run into underground brick-built separators, out of which the tar and liquor flow into separate compartments of two large underground tanks situated under the condensers. The tanks at the north works are 88 feet long by 57 feet wide by 8 ft. 6 in. deep to the overflow level, and at the south works 184 ft. 4 in. long by 47 ft. 3 in. wide by 11 ft. deep to the overflow level. They are strongly built in brick work, rendered water tight by a thick backing of clay puddle on the outside, and lined with cement on the inside. The tanks are covered throughout by substantial brick arches supported by piers and division walls, which bear the weight of the condensers and the other apparatus superposed upon them.

There are also a number of overhead tar and ammoniacal liquor cisterns in different parts of the works, into which the liquor is pumped and afterwards discharged by gravity into pipe lines or barges and passed on to the contractors' bye-products recovery works. By these means, very effective separation is obtained.

The liquor from the carburetted water-gas plant, together with the cooling water from the condensers, passes into two series of three settling tanks each. They are provided with inlet boxes, fitted with four pipes underneath, extending

downwards, whereby all the heavier liquor is induced to descend towards the bottom; while the lighter liquor rises to the surface and flows through four adjustable branch pipes on the top of the inlet box. The final tank of each series is an old underground brick tank, formerly used for tar and liquor in connection with the coal-gas plant.

Cyanide Plant.—In connection with the south coal-gas works, a Davies-Neill cyanide plant was erected in 1905. The plant is accommodated in a two-storey building, and is capable of dealing with gas from 500 tons of coal per day. With a small additional outlay it can be made to deal with the whole of the coal gas produced at Linacre. Since its introduction no inconvenience or nuisance has been caused by the operations, and the financial results have so far been quite satisfactory.

The cyanogen in the gas is extracted by the action of a solution of soda and ferrous carbonate in the "Standard" washers. The resultant liquor is passed through a still, so that any ammonia in it may be driven off by means of wet steam. This is condensed and run into the liquor wells. The cyanide liquor is passed through a filter-press to separate insoluble matter. The clear solutions and washings from the filter-press are concentrated by dry steam in a Kestner evaporator and run into vats to crystallize. The crude crystals (sodium ferrocyanide or prussiate of soda) are washed with mother-liquor to remove the soda and insoluble matter, and then re-dissolved in a small quantity of hot water. Any insoluble matter is allowed to settle, and the clear liquor run into crystallizing vats, where the prussiate of soda slowly forms saleable crystals on pieces of rope that are suspended in the liquor. The mixture for use in the washer is prepared in special vessels, and the precipitated ferrous carbonate is separated from the sodium sulphate solution by filter-presses, and then mixed with soda and water. Steam is taken from adjoining boilers.

Connections.—The works mains are 18 inches to 42 inches in diameter; the latter being put in last year in anticipation of a large extension of carburetted water-gas plant in the near future.

In addition to the ordinary mains, special mains have been provided connecting the north coal-gas-works with the south works. These mains are particularly useful in the summer time, allowing greater freedom in purification; all the purifiers, in both sections being available, when one section is closed down for repairs.

Shops.—The works are fully equipped for dealing expeditiously with repairs and renewals to machinery and plant. The machine-tools include a 15 cwt. steam-hammer, lathes, shaping machines, drilling machines, &c. The shops comprise smithy, machine shop, fitting shop, electrical fitting shop, joiners' shop, stores, paint shop, &c.

Laboratories.—Chemical and photometrical laboratories are provided for each section of the works; and in addition to the experimental works already mentioned there are also smaller experimental plants for carrying out tests on a smaller scale. A "Sarco" recording calorimeter is in constant use for continuous readings of the calorific power.

Recreation Rooms.—A description of the Linacre works would be incomplete without a reference to the recreation rooms, furnished with two billiard tables, piano, &c., provided for the use of the employees. A social club and a football club were established some years ago, and continue to flourish; a large football field being provided by the Company.

It is unnecessary to describe the other five works of the Company in detail, as the plant is similar in most respects to that already described in connection with the Linacre works. Certain special distinguishing features of the other works will, however, be briefly mentioned.

Athol Street Works.

These works are the only ones of the Company where inclined retorts are in operation. There are four benches, with a total capacity of about 3 million cubic feet per day. The gas made is from coal only, of about 12-candle power in a flat-flame burner. It is not distributed in this state, but is pumped through the "messenger" main to Garston, where it is mixed with an equal quantity of carburetted water gas. The mixture is then distributed on the district, having an illuminating power of 18 candles in the flat-flame burner.

At Athol Street, smiths, fitting, and machine shops are provided for dealing with special repairs required at three of the other stations, in addition to Athol Street.

A special feature of these works is an installation of the "Primus" pan ash washer, situated in a corner of the coal-store adjoining the south retort-house. It deals with the whole of the production of pan ash from the Eccles Street works as well as the Athol Street works. The pan ash is deposited over a grating level with the floor; the small passing through into a hopper feeding the boot of a bucket elevator. The large lumps held back by the grating are broken by hand. The pan ash is then elevated into an overhead feeding hopper, from which it passes into a cast-iron box. The bottom of the box is perforated, and is also fitted at one end with a door held in a closed position by levers and balance weights. The box has a vertical reciprocating motion in a tank of water.

The heavier portion of the pan ash, which is the refuse, works its way to the bottom, and accumulates until its weight is sufficient to open the door, through which it passes out, and falls to the bottom of one compartment of the tank. The lighter portion, which is the recovered coke, keeps near the surface of the water in the box and passes over a weir provided for the purpose, and thence to another compartment of the tank. Two small bucket elevators are provided—one for clearing the refuse out of the tank and placing it in an overhead hopper. The other is used in a similar manner for clearing the recovered coke from the tank and placing it into another hopper, from which carts can be directly loaded. The whole plant is worked by an 8 B.H.P. gas-engine.

Eccles Street Works.

At these works, one special feature worthy of note is the coke-handling plant. The coke is discharged from the retorts by the Fiddes-Aldridge machine into a rectangular skip formed of steel plates, angles, &c., provided with trunnions and resting upon a loose two-wheeled carriage. The filled skip and carriage is wheeled by hand to one of the quenchers, of which there are two, similar to those already described in connection with the north retort-house at Linacre. After quenching, the skip is wheeled to a point immediately outside the doorway of the retort-house, where it is picked up by a steam travelling jib-crane running on an elevated craneway. By means of gear specially designed for the purpose, the crane driver is able to discharge the skip into the receiving hopper of the coke-screens or on to the stock heap at any point alongside the craneway, as desired.

The receiving hopper is placed at one end of, and discharges on to, a Zimmer conveyor, 4 feet wide and 48 feet long, the first portion of which, for a distance of 15 feet, is perforated with holes ½-inch square, for taking out the dust. The conveyor is made in two lengths, worked by cranks on opposite centres, so that the momentum of one length in one direction is balanced by the momentum of the second length in the opposite direction; thus obviating excessive vibration. Sliding doors are provided along the conveyor at intervals, through which the coke passes to the coke-bunkers.

The coke-bunkers are constructed throughout in reinforced concrete on the Kahn system. They are 48 ft. 9 in. long by 11 ft. 9 in. wide by 14 ft. 6 in. deep, fitted with sliding doors at the bottom, operated from the ground by chain, wheel, and screw. Three of the doors are 9 feet from the ground for filling carts, and the other door is 10 ft. 6 in. from the ground for filling motor-waggons. A separate compartment is provided under the screen for the coke dust.

The conveyor is driven by an 8 B.H.P. motor controlled by an automatic starting panel operated by a tumbler switch in the crane-driver's cabin. The hoppers are of 80 tons capacity—equal to about one night's make of coke. By these means the coke is handled at a very low cost, and the cart and motor traffic are expeditiously dealt with. The craneway has made it possible for a much larger quantity of coke to be stocked in the very limited space available than was possible under the old conditions.

At Eccles Street also is to be seen a Feld vertical centrifugal washer. This washer is 4 feet in diameter by 15 ft. 6 in. high, with six washing chambers, and is driven by a 4 B.H.P. motor. It was originally installed for the purpose of entirely removing the tar from the gas by washing with hot tar, and answered the purpose admirably. Unfortunately considerable trouble was experienced owing to the blocking of the condensers which followed the washer, by naphthalene salts. At present the washer is used for

washing the gas with ammoniacal liquor to assist in the removal of the impurities.

Wavertree Works.

At the Wavertree works there are a few special features of interest. The coke plant consists of a Temperley transporter, with skips and quenching arrangements similar to those described in connection with the north works, Linacre. In this case, however, the skips are emptied through a receiving hopper on to a reciprocating coke screen, which can be moved, by means of gearing and a chain wheel, to any point in the length of the storage hoppers. It can also be moved to a position close to the railway siding, and the coke passed directly into the railway waggons from the coke-screens. This arrangement has been found of very great service, and has made a big reduction in the cost of loading the coke required by rail.

The coke storage hoppers are constructed of steel, and lined with cement. They are 60 feet long by 11 ft. 6 in. wide by 7 ft. 9 in. deep overall, with a longitudinal division for separating the dust from the screened coke. Sliding doors are provided at the bottom for feeding the coke and screenings into carts. Over one end of the coke-bunkers, a 10-ton per hour Tanner coke breaker and screen is now being fixed, for breaking the coke to a size suitable for domestic use. The skips of the Temperley transporter are discharged directly into the receiving hopper of the coke-breaker.

Special means have been adopted at Wavertree to overcome the naphthalene trouble, which presented itself a few years ago very acutely, both on the works and on the district supplied by the Wavertree works. To deal with the former a Holmes washer-scrubber was erected, just after the "Standard" washer, in which the gas is washed with water-gas tar. Considerable reduction in the naphthalene content has been effected in this way; and the blocking of the inlet and outlet pipes to the gasholders, which at one time was most frequent, is now a thing of the past.

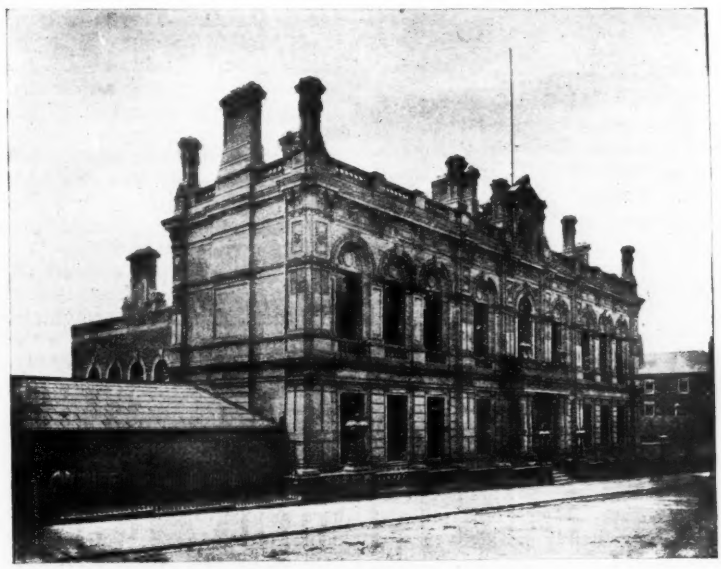
For dealing with the salts in the mains on the district, a Simplex "Vaporizer" has been fixed, in which Russian vaporizing oil is vaporized and passed out along with the gas into the district. The complaints, which were at one time numerous and ever-recurring, have now been entirely removed. A connection from the vaporizer to the main gasholder inlet has also been fixed, so that the vaporizing oil may be passed into the inlet of the holders, if found desirable, instead of passing direct to the district. The vaporizer is accommodated in a small galvanized iron house in which a Maxim carburetting plant is also housed.

Owing to difficulty in maintaining maximum pressures in the evening, a booster, driven by an electric motor, having a capacity of 300,000 cubic feet per hour, has just been put in. It has been placed in a small house, with a flat roof, specially built to receive it and to match the valve-house in the gasholder yard which is in close proximity to it. By means of the booster, the gas in the light holders may be driven into one of the heavier holders, or directly into the inlet of the governors.

At Wavertree, as at all the other works of the Company, the station governors, five in number, have been of the old Liverpool type. These are now being displaced by three modern Cowan's compensating water-loaded governors, each with a capacity equal to a 24-inch pipe. The new arrangement of valves and connections will permit of the three main districts being supplied through three governors (one to each), or through any two governors or any one according to requirements or circumstances.

Garston Works.

In connection with the Garston works, special mention should be made of the 6-inch oil-pipe line, laid in 1910, from the Stalbridge Dock, through the streets to the storage tanks at the works—a distance of about half-a-mile. The pipes are of steel $\frac{7}{16}$-inch thick, lap-welded, and were tested to a pressure of 1800 lbs. per square inch. By means of flexible connections at the Dock quay, the pumps of the oil-ships are connected to the pipe line, and a large cargo—say, 5000 tons—can be discharged and placed into the Company's tanks in the course of a few days at practically no expense. The pipe line is also used for filling tank-barges, which are employed to convey oil down the river and canal to the Linacre works.



Head Offices and Show-Rooms of the Liverpool United Gaslight Company.

There are four oil-tanks at Garston, the sizes of which are given in the following table:—

Tank.	Diameter.	Depth.	Capacity.	Capacity.
	Feet.	Ft. in.	Gallons.	Tons.
No. 1 . . .	50	25 0	306,000	1177
,, 2 . . .	50	25 0	306,000	1177
,, 3 . . .	18	25 0	39,500	152
,, 4 . . .	90	28 6	1,131,000	4350
			1,782,500	6856

Carburetted Water-Gas Plant.—This consists of four sets, having a nominal capacity of 800,000 cubic feet each per day. Two of the sets are being remodelled on the same lines as the Linacre sets, and will then have a capacity of 1½ millions each. All the sets are provided above the roof of the generator-house with blast-products scrubbers, which have been very effective in preventing the deposition of coke dust over the surrounding area, and at the same time deodorizing the waste gases.

The coke required for the generators at Garston is brought from the town works by rail; the waggons being raised to the coke-store floor alongside the operating floor of the generating house by means of a hydraulic hoist.

Gasholders.

The gasholders at Linacre have already been enumerated.

Those at the other stations are without exception provided with guide-framing extending to the full height. The standards consist of either cast-iron columns or steel lattice standards. A list of the other gasholders is here appended:

Works.	No.	No. of Lifts.	Size of Outer Lift. Diameter		Depth.		Full Capacity.	Maximum Pressure.	Date of Erection.
			Ft.	In.	Ft.	In.			
Athol St.	1	2	100	0	52	0	384,000	45-10ths	1863
	2	2	100	0	52	0	384,000	45-10ths	1863
	3	2	120	0	25	9	527,000	40-10ths	1854
	4	3	112	6	26	9	705,000	81-10ths	1894
	5	3	112	6	26	9	705,000	81-10ths	1894
Eccles St.	1	2	145	2	30	0	923,800	65-10ths	1875
Caryl St.	1	3	90	0	24	6	426,035	84-10ths	1806
	2	3	80	0	24	6	333,829	90-10ths	1846
	3	2	80	3	24	3	350,483	52-10ths	..
	4	2	125	0	30	0	686,891	45-10ths	1858
	5	2	197	6	40	6	2,332,037	64-10ths	1883
Wavertree	1	3	104	6	26	9	639,975	91-10ths	1904
	2	2	105	0	26	0	400,000	52-10ths	1859
	3	3	104	6	26	9	639,975	91-10ths	1904
	4	2	105	0	26	0	400,000	56-10ths	1855
Garston	1	3	212	6	40	0	4,094,300	92-10ths	1891
	2	1	70	0	25	3	120,000	15-10ths	1896

Special mention should be made of the construction of the large gasholder tank at Garston. It is an annular tank cut out of the solid sandstone rock by blasting. The sides of excavation are lined with brickwork in cement, and rendered watertight by a 1-inch thickness of asphalte, protected on the water side by 9 inches of brickwork.

Area of Supply.

The area supplied by the Liverpool Gas Company was until this year about 40 square miles in extent—reaching from Garston in the south to Great Crosby in the north, extending eastward as far as Croxteth Park, and bounded on the west side by the river. This area included the whole of the City of Liverpool, except Fazakerley (supplied by the Corporation) and Woolton (supplied by the Woolton Gas Company); it also includes the borough of Bootle and the districts of Ford, Seaforth, Waterloo, Litherland, and Great Crosby.

By the Bill of 1914, power has been sought to extend the area of supply so as to include Childwall, Ince Blundell, Thornton, Lunt, Sefton, Netherton, and Aintree. The total area of supply, including the added districts, is 51 square miles, extending along the river side for 14 miles.

Distributing Mains.

The total length of the main pipes laid is 924 miles, of all sizes from 36 inches diameter downwards. This mileage includes a number of large mains which do not deliver until they reach the heart of the district to be supplied. There are 29 districts, each controlled by its own station governor. The maximum pressure given at the outlet of governors is 42-10ths.

Offices and Show-Rooms, Duke Street.

This imposing and commodious building was erected in 1872, and forms the headquarters of the Company's business. There is a show-room on each side of the entrance hall, and a large public office facing the doorway. A handsome staircase leads to the Engineer's offices and board room on the first floor. Additional office accommodation is provided at the rear of the building, and the basement is utilized for stores, book-room, cloak-room, lavatories, &c.

Workshops, Kent Street.

These premises adjoin the offices, and stand upon an area of 700 square yards, and consist of a four-storey brick building forming the west boundary of the Company's property.

Basement.—In the basement accommodation is provided for power machines used in the preparation of the parts required in the manufacture and repair of meters and other appliances, and also a complete toolmaker's plant and machinery. In addition, the manufacture and repair of gas-fittings is carried out by a dozen men; and in an adjoining room there are appliances for buffing, polishing, and lacquering. Power is provided by a gas-engine for driving the machinery and also for working the gas and air compressors. The spacious meter test room, with sixteen holders, provides constant work for eight men testing and proving meters.

Ground Floor.—There is a large store-room for the accommodation of tin-plate, meter parts, and gas-fittings. It occupies half the length of the building, and the remaining portion is used as an office. In this room delivery of meters and auto-fittings is given each morning to the gas-fitters to be taken to the various jobs, and delivery is here taken of meters to be examined and tested.

First Floor.—Situated on this floor are the following shops—viz.: Gas-cooker repair and fitting shop, joining shop, and meter stores to accommodate 10,000 meters, with a lift for communication to the office.

Top Floor.—This is divided into two long shops for the accommodation of a large staff of meter makers, who deal with the repair and manufacture of ordinary and automatic meters, both wet and dry. This business has been carried on by the Company for about seventy years.

Cornwallis Street Building.

This building is used in connection with the gas-fittings department. Gas stoves, chandeliers, brackets, and other gas appliances are stored, and also the piping and other materials required in gas-fitting work. The fitters assemble here to receive orders and materials; and a large room is placed at their disposal for meetings of their Guild. Accommodation is also provided for the work of training the gas fitter apprentices.

HIGH-PRESSURE GAS LIGHTING IN PARIS.

Development of the System.

Recent issues of the "Génie Civil" have contained a series of articles by M. André Grebel on the public lighting of Paris. The author deals with the subject in the exhaustive manner which characterizes his work; and he has brought together a very interesting collection of data in regard to both gas and the electric lighting. We must leave for the present a fuller notice of the articles, and confine ourselves to the reproduction of some statistics showing the remarkable development of high-pressure gas lighting in the public thoroughfares which has taken place in the past four years.

At the close of 1910 the total length of mains on the high-pressure system was about 6200 yards; at the corresponding period the following year it was close upon 25,000 yards; at the end of 1912 it was 42,300 yards; and on Dec. 31 last it had risen to 67,340 yards. The following table shows how the number of lamps installed has increased in the period under consideration:

Year.	500 C.P.	1000 C.P.	2000 C.P.	4000 C.P.	Total.
1910.	—	7	68	29	104
1911.	—	7	305	68	380
1912.	—	38	315	117	470
1913.	16	193	875	159	1243

The light-giving power of these lamps at the four periods named is put by M. Grebel at 259,000, 882,000, 1,536,000, and 2,587,000 candles. It will be noticed that there was a considerable increase in the number of 2000-candle power lamps installed last year as compared with 1912. This was the result of a decision come to by the Municipality to extend both the low and the high pressure lighting; and M. Grebel states that the total number of lamps on the latter system will soon reach 2800, representing approximately the light-giving power of 6 million candles.

The lamps installed last year were of the types and of the nominal illuminating powers stated below:

	500 C.P.	1000 C.P.	2000 C.P.	4000 C.P.
Graetzin	—	—	501	103
Pharos	—	90	92	34
Auer	16	103	254	19
Keith	—	—	12	3
Pintsch	—	—	16	—
Total	16	193	875	159

In a previous issue of the "Journal," particulars were given of the plant at the compressing station on the Boulevard Raspail. This has been increased, and two other stations have been equipped. Collectively they are equal to compressing about 184,000 cubic feet of gas per hour. They are connected by 6½ inch mains, and are in telephonic communication with each other and with the distributing system. This consists of pipes of 4¼ and 3¼ inches diameter of the Chameroy type, divided into sections separated by valves, with the view of easily locating escapes, which are specially to be feared with the pressure of 63 inches of water necessary during the lighting hours.

In his concluding remarks M. Grebel says the numerous statistics he has brought forward in his articles testify that gas retains its supremacy in the street lighting of Paris. With regard to high-pressure gas, it continues to develop rapidly, "as the public prefer its beautiful light to that of the flame arc lamp." He adds that with the facility it affords for reducing, during the hours of lessened consumption, the power of all the light centres without diminishing their number, it remains a cheaper medium of illumination than the improved electric arc lamps fitted with enclosed mineralized carbons.

BRITISH COMMERCIAL GAS ASSOCIATION.

Report of Executive Committee.

THE General Committee of the Association met last Tuesday, when the Executive Committee submitted a report as to the progress made, and the activities that had engaged attention, since the previous general meeting. The following are some extracts from the report.

ADDITIONAL SUBSCRIBERS.

It is with pleasure that the Executive report further additions [17 in all] to the steadily growing list of subscribers. After mentioning the names of the undertakings, the Committee express their opinion that the District Conferences have contributed to this satisfactory result. Three candidates are recommended for election as associate members (Mr. G. A. Mallett, Ipswich, Mr. Ivan Horder, Bordon District, and Mr. E. V. Pleasants, Hayward's Heath), and one (Mr. Chas. H. Nettleton, of Derby, U.S.A.) as an International Member.

NATIONAL GAS EXHIBITION ESSAY COMPETITION.

The Executive authorized a payment for prize awards amounting to £40 to the successful competitors in the essay competition arranged in connection with the National Gas Exhibition. The number and quality of the essays written by the general public exceeded even the most optimistic expectations of the Committee and others responsible. The essays indicated clearly what the educative value of the exhibition has been to the woman in the home and to the children who will constitute the next generation of wives and mothers; and the far-reaching effects of this education can hardly be estimated.

DISTRICT CONFERENCES.

Since the last meeting of the General Committee successful District Conferences have been held:

At Plymouth on March 13, under the presidency of Sir Joseph Bellamy.
At Bradford on March 17, under the presidency of Mr. Councillor J. H. Barraclough.
At Glasgow on April 1, under the presidency of Bailie Thomas Paxton.
At Newport on April 23, under the presidency of Mr. T. Cartwright.
At Redhill on April 27, under the presidency of Mr. William Lees Stenning, J.P.
At Newcastle on May 1, under the presidency of Sir William Stephenson.
At Leicester on May 8, under the presidency of Alderman T. Smith, J.P.

The Secretary attended each of these conferences, and reports that they were all very successful, and appear likely to do the cause of the industry and of the Association much good in the districts concerned. The seven new subscribers from Wales may undoubtedly be credited to this work, and to the special efforts of Mr. Clarry, the representative of that district on the General Committee. Each conference is being followed up by the circularizing of the non-subscribing undertakings in the district.

[The General Committee adopted a resolution expressing their special thanks to the Local Committees and to those who presided over the district conferences for their valuable services in this connection.]

ASSISTANCE RENDERED TO SUBSCRIBING UNDERTAKINGS AND TO THE PUBLIC.

The Association continues in an ever-increasing degree to be consulted on many points of interest to the members. In an appendix to the report is given a brief summary of some of the cases in which assistance has recently been asked and given; and this gives an indication of the part which the Association now plays in the daily work of the industry. It would, however, be quite impossible to indicate adequately the amount of advice which is continually being asked for by members of the public—not only by correspondence, but by personal calls at the head office.

It is perfectly evident that the Association is looked on as an independent organization, and we are, therefore, enabled in many instances to give valuable assistance and advice, which, of course, re-acts to the benefit of the industry.

We are continually being referred to for information regarding furnaces, water heaters, wash boilers, fires, and indeed practically every kind of gas appliance.

PAPERS BEFORE THE INSTITUTE OF SANITARY ENGINEERS AND THE ROYAL SANITARY INSTITUTE.

The Committee report with satisfaction that, as a result of the National Gas Congress, Mrs. Cloudesley Brereton and Professor Vivian B. Lewes were invited to read papers before the Institute of Sanitary Engineers on questions of gas heating, cooking, and hot-water supply. The papers attracted large audiences. The Royal Sanitary Institute have invited Mrs. Cloudesley Brereton to read a similar paper at their annual congress at Blackpool next month.

TORONTO ADVERTISING CONVENTION.

It is particularly pleasing to report that the advertising men of this country have—voting in open competition—elected our press advertising as being worthy to represent (along with some nineteen other large advertisers) the best British advertising at the forthcoming convention of the Associated Advertising Clubs of America, to be held in Toronto from June 20 to 27. This honour reflects great credit on our Advertising Agents and the Editor, and confirms the good opinion of advertising experts (frequently expressed) as to the high-class nature of the advertising done by the Association. It is certainly gratifying that an Association, which has only been in active operation for a little over two years, should be, by those best able to judge, reckoned worthy of an honourable place beside some of the greatest commercial advertisers in the world. A large volume has been prepared and despatched, in which are mounted and classified typical illustrations of advertisements issued by the Association. This volume was, when completed, in itself a revelation even to those who have been in every-day contact with the work of the Association, and will be of much value in future work in connection with various conferences, as showing subscribers and others the comprehensive manner in which the publicity campaigns have been carried out.

(Signed) F. W. GOODENOUGH,
Chairman of Executive Committee.

The appendix above referred to is a brief summary of assistance given to subscribing undertakings. Omitting names of places, &c., the following were some of the items enumerated:—

Providing a selection of advertisements suitable for display on special board in show-rooms.

Furnishing article for local press on "Light and Eyesight."

On the question of the alleged detrimental effect of gas on pianos.

Interview with architect in London of local Cottage Hospital, who promised to give gas installations consideration.

On the subject of acetylene gas competition with coal gas at 5s. 6d.; and on the question of gas for lighting and heating picture palaces. This latter point formed the subject of the May issue of "A Thousand and One Uses for Gas" and of articles in the "Bulletin" for that month.

Drafting letter to town clerk of local authority regarding street lighting contract.

Submitting a scheme to light the bandstand in the public gardens.

In reference to the Board of Trade inquiry into the application of the Balcombe Petrol Gas Company for an Order. Supplying statistics showing general progress of the gas industry.

Supplying information to a local doctor who is prejudiced against gas.

As to the practice with regard to the sale of sulphate of ammonia—through brokers or by tender. This was referred to the Sulphate of Ammonia Committee.

Helping to fight strong electrical opposition. Special draft-letter sent to the editor of the local paper.

In an effort to displace acetylene for the lighting of a station and goods yard; and in an effort to compete with electricity generated on a works by a plant having a good day-load.

As to lighting of miniature rifle ranges.

In regard to the lighting of public baths. The correspondence is of interest, and has been the subject of a note in the "Bulletin." [May, pp. 52 and 56.]

Conducting special correspondence with influential local sportsman regarding coke.

On the question of alleged unsuitability of incandescent burners for the lighting of schools. The Education Committee (strongly biassed in favour of electricity) have since given an order for installing incandescent burners, subject to a guarantee of success.

In regard to a proposal to adopt electricity for the lighting of a new pier. We communicated with the Consulting Engineer to the Harbour Commissioners. A resolution in reference to the adoption of the electric light has since been rescinded.

As to the use of coke as fuel for steamships. Information supplied by Mr. Carr, of Wandsworth, appears in the May issue of the "Bulletin," p. 63.

By giving information respecting the use of coal gas for testing petrol motor-car engines.

By carrying on correspondence in local paper on the question of Gas *v.* Electricity for Cooking, and issuing a challenge which has not been accepted.

In fighting to retain a large consumer for power—against suction gas. The engineer hopes to be successful, and states that the information sent him will be of good use.

In trying to secure the lighting of a large motor-bus garage, in face of strong electrical competition.

In fighting against a proposal to instal electric light in the congregational church.

In trying to get a gas-engine installed in place of steam. A 20 B.H.P. gas-engine has since been fixed.

In an attempt to secure the lighting of the workhouse, at present lighted by oil, in competition with electricity.

In the "JOURNAL" for the 12th ult., we noticed briefly a paper submitted to the Yorkshire Section of the Society of Chemical Industry, by Professor J. W. Cobb, B.Sc., the Livesey Professor of Coal Gas and Fuel Industries at the Leeds University, and Mr. G. Dougill, on "Corrosion by Dissolved Oxygen." The paper has been reprinted in pamphlet form, and we have received a copy from the authors.

PERSONAL.

Mr. H. VERSEY, the Manager of the Ashburton Gas-Works, has been appointed Manager of the Dawlish Gas-Works.

Out of 123 applications received for the post of Engineer and Manager of the Epsom Water-Works, Mr. T. N. YOUNG, son of the late Manager, has been appointed.

At the meeting of the Nottingham Corporation on Monday last week, it was decided by a unanimous vote to augment the salary of Mr. JOHN WILKINSON, their Gas Engineer and Manager, by £100 a year—making it £1200.

The Manchester Corporation Gas Committee, on Friday, elected Alderman THOMAS HASSALL to be Deputy-Chairman of the Committee in succession to the late Alderman JENNISON. Alderman Hassall has been a member of the City Council for nineteen years, and has been for many years Chairman of an important Sub-Committee who deal with street-mains and lighting.

OBITUARY.

DEATH OF MR. JOHN CHEW.

THE death has taken place at Blackpool, at the age of 88, of Mr. JOHN CHEW, who for more than fifty years was Gas Engineer to the Blackpool Corporation. Until a few months ago, he was actively engaged on his duties; and when he resigned, his son, Mr. William Chew, was appointed in his place. A native of Newcastle (Staffs.), the deceased received his early training at the Rochdale Road Gas-Works, Manchester; and he was President of the Manchester District Institution of Gas Engineers in 1881.

The late Mr. Chew went to Blackpool at Christmas, 1862, to take control of the then privately owned gas undertaking, being engaged, says the "Blackpool Gazette-News," by the lessee, a Mr. Wm. Crippen, of Manchester, on the condition that he could make the works pay, for hitherto they had been run at a loss. When Mr. Chew took charge, the price of gas was 5s. 10d. per 1000 cubic feet; and one of the first things he did was to reduce it to 5s. He steadily built up the undertaking, until he had placed it on a sound footing; and in 1870, when the Corporation took over the works, the net profit was £1029, which went to the relief of the rates. Ten years later, the price of gas stood at 3s. 9d. per 1000 cubic feet; and the works yielded a profit of £2750. In 1890 the charge to consumers had gone down to 2s. 6d., and the profit had risen to £4300; while in 1904 the price was 2s. 4d., and the profits reached the sum of £13,000. In 1910 there were further concessions, the price being 2s. 2d. for lighting and 1s. 10d. for power, and still the profits were £11,600; while in 1913 the surplus was £15,000. The price of gas to-day in Blackpool is 2s. per 1000 cubic feet. Since the gas works became the property of the town, they have contributed the sum of £276,000 towards the relief of the rates, and in addition £10,000 has been taken from the department towards paying for the site of the new Art Gallery and Library, and another £2000 towards the finishing of the latter. "Figures such as these," concludes the writer, "show that Mr. Chew succeeded in building up his department into one of the most profitable undertakings of its kind in the country." The gas consumers in Blackpool when Mr. Chew was appointed Manager numbered 650; and there were eight employees. To-day there are some 17,000 consumers and about 200 employees.

The funeral took place at Blackpool Cemetery last Friday.

The death is announced of Mr. E. BINDON MARTEN, who had carried out many important engineering works in the Midlands. Many years ago, he took a lease of the undertaking of the Stourbridge Water-Works Company; and after holding it for eight years, he became Engineer and Manager of the Company—a position he retained until the end of 1909, when the undertaking was transferred to the Stourbridge and District Water-Works Board.

The death occurred at Keswick, on Monday last week, in his sixty-fourth year, of Mr. THOMAS HEYWOOD, Manager of the Keswick Gas Company, a position he had held since 1886, when he was appointed on the recommendation of Mr. Joseph Hepworth, then of Carlisle, the Consulting Engineer to the Company. Under his enterprise and successful management, the works were extended and put on a prosperous footing. He was a member of the Gas Institute, having been admitted in 1891; but he did not pass into the Institution. He is survived by his wife, three sons, and a daughter. Two sons and the daughter are in Canada; and the other son is employed in the Keswick Gas-Works.

Discs in Prepayment Meters.

The Sacramento (California) Gas Company is seeking authority to demand a deposit of $5 (over £1) before giving a supply of gas through prepayment meters, and at the same time to increase the price for prepayment consumers to $1.50 (6s. 3d.) per 1000 cubic feet. The authorities maintained that the prepayment system is in itself a guarantee, since no gas can be obtained until a coin has been inserted. To answer this, the Company produced over 25 lbs. of discs of various kinds which were found in prepayment meters last year. It is to stop such fraudulent practices as this that the Company is asking for permission to have a deposit even on prepayment meters.

ELECTRICITY SUPPLY MEMORANDA.

THE gas industry has found that, in spring and early summer, water heating is a good line of business to take up; and with the improved and highly efficient appliances that they have now to offer (but which appliances, it must be admitted, require installation by men who have had a training in hot-water work, and not the ordinary fitter who knows all about the gas-piping of houses, and the fixing of burners, cookers, and fires, but nothing else), a gratifying expansion of the business is taking place. The struggles of the electrical people to emulate the gas industry in this line have not met with a generous success. The "Electrical Times" freely concedes this fact in its preface to a notice of the "Losles" electric water-heater, which is the invention of Mr. George Wilkinson, of Harrogate. The writer says: "It cannot be denied that most electric water-heaters at present available are costly in operation, and, even apart from cost, do not, in some cases [the qualification has an excellent flavour about it], form a really satisfactory alternative to the kitchen boiler." It proceeds to state that "fortunately the problem is being attacked by some of the best brains in the industry; and there is no doubt that an electric system will, sooner or later, be evolved that will meet successfully the special conditions of hot-water supply, at a cost no greater than that of coal." We take it that Mr. Wilkinson possesses a part of the best brains in the electrical industry; at any rate, we should not like to affront him by suggesting that he had not. But it is not complimentary to the new "Losles" electric water-heater to suggest, by the use of the words "no doubt" and "sooner or later," that it does not "successfully" meet "the special conditions of domestic hot-water supply." Anyway, our contemporary does not show any very exuberant sanguineness that Mr. Wilkinson has succeeded where others have failed. What he has tried to do has been to devise something that shall assist electrical operation, in connection with the domestic circulating system, by saving the heat losses of the ordinary hot-water storage tank. But looking at the diagram of his proposal, with some knowledge of the variable positions of the storage tank in houses, and of the points at which hot water is required from the sink in the scullery up to top floor lavatory basin, we are not convinced that he has been very successful, quite apart from the dearness of electrical thermal energy. Mr. Wilkinson only calls his invention an auxiliary water-heater; and this, according to the description in our contemporary, is placed "between the ordinary hot-water cylinder and the service-pipes on the various floors—the idea being that, when the electric-heater alone is in circuit, the heated water shall flow direct therefrom to any of the draw-off taps without passing through the hot-water cylinder, the kitchen boiler, or the piping system connected therewith." So, it is suggested, the *only* losses are those due to radiation and convection from the electric-heater itself, and the lengths of piping to the draw-off taps; and these losses are said to be "very small." When the kitchener is in operation, the heated water circulates through both the ordinary water cylinder, and the electric-heater; and, provided its temperature is greater than that for which the thermostat is set, the electric-heater is cut out of circuit. When the kitchener is not in use, the electric-heater takes up the whole duty, and "maintains a constant temperature in the upper storage cylinder, at a minimum power consumption." A fault in the description is that no information is given as to the power consumption in relation to work done, so that there is no basis upon which criticism, or rather investigation, of the claims can be made.

Water Heating.

"Magnet" Appliances.

Last week, in a paragraph with the side-heading "Methods of Popularizing," reference was made to a card in a St. Paul's Churchyard shop window that had attracted our notice. The card made certain allegations respecting the capabilities of a unit of electricity, some of which allegations we could not get to square with our own knowledge of the heat capacity of electricity, nor with the efficiencies of electrical apparatus. Since then attention has been directed to a booklet issued by the General Electric Company, over which Company we have hitherto spread the best of virtues to be found in electrical trading. This booklet has in a measure shaken the opinion, which can only be re-established by an explanation on the part of the Company concerned. In a "Foreword" in the booklet, it is stated that, in the modern home, electricity is now almost universally adopted for lighting purposes. That we absolutely deny; and we should be under an obligation to the Company if they would give us their views as to how it is the consumption of gas during the hours of darkness in this country is more than equal to what it was when the first Electric Lighting Act was passed, with the total annual consumption much more than double what it was then—all this notwithstanding that, through the incandescent burner supplanting the flat-flame burner, the quantity of gas required to produce a 20-candle light has been reduced from nearly 10 cubic feet to 1 cubic foot. It is confessed by the Company that, at the use of electricity for lighting, many consumers halt. "They have not," says the writer, "realized that the same advantages apply, with even greater force, when electricity is used for heating, cooking, and numerous other domestic purposes." There is partial truth in this; for the gas industry is well aware, by renewals of custom

in these directions, that many electricity users have failed to "realize" the "advantages" that very elastic imaginations have attributed to the use of electricity for certain domestic purposes other than lighting. The booklet is designed to advertise the "Magnet" appliances manufactured by the Company. In these appliances, the feature of the system is the employment of heating elements which, it is said, are easily replaceable at an extremely moderate cost. The heating elements or coils vary in price from 2s. 6d. up to 15s. apiece! In the case of electric fires, each of the elements required costs 7s. 6d. In most cases, except electric-irons, the Company only give a guarantee of twelve months, for the reason, we take it, that the renewal of the heating elements is not a negligible matter. The first cost, too, of the appliances is a great deal more than that of appliances used in gas-heating. Electric-irons are listed at 13s. 6d. and 16s.; toasters at 15s. and 21s.; ketttles (2-pint), at 22s. 6d. and 34s. 4d.; kettles (3-pint), at 28s. 6d. and 41s. 6d.; cooking-plates (only 6 inches diameter), at 18s.; a griller, toaster, and hot-plate (6½ in. high, 13½ in. wide, and 9½ in. deep), at 40s.; and electric-fires: For rooms 12 feet square, 45s., 60s., and 80s.; for rooms 16 feet square, 55s., 75s., and 80s.; and for rooms 18 feet square, 105s. Whether in winter electric "fires" are equal to the heating duty claimed for them, is a matter upon which opinions vary—the affirmative generally being electrical, the negative non-electrical.

Freakish Results.

These figures show that for these small domestic electric appliances, first costs and renewals (without including anything for wiring and installation) are not such as the mass of the people can afford to indulge in; notwithstanding the assertion in the booklet that there is a positive saving in household expenses by using electrical appliances. But it is in connection with the cost of running some of the appliances that we find greater interest, and a desire for explanation. The costs are based upon electric current at 1d. per unit; and, in mentioning this, the booklet states that it should be pointed out that in a large number of districts, the cost for electricity for heating and cooking purposes is only ½d. per unit. We have, so far as statistical publication permits, counted up the number of districts charging only ½d.; and our view as to what constitutes a "large number" does not concur with that of the "G. E. C." Now with regard to the "Magnet" kettle, with heating element complete. It is said that 2 pints of water can be boiled in this in twelve minutes; and that, as to the "approximate" cost of using the kettle, with current at 1d. per unit, it will boil 20 pints of water for 1d. This statement pulls us up sharply. What, pray, is the efficiency of these kettles? It appears to be a quantity exceeding the theoretical. The 20 pints are equal to 25 lbs. of water, at 62° Fahr. But water drawn from the tap is not, as a rule, at anything like 62° Fahr. Take it at 48°; in wintry weather, it would be much below that. To reach boiling point, we have to raise this water 164° × 25 lbs. = 4100°; and theoretically every degree requires 1 B.Th.U. Will the G.E.C. explain how it comes about that not only are there no losses in connection with the "Magnet" electric-kettle, but that its efficiency exceeds the theoretical bounds? Turning over a leaf, we see that the "Magnet" (6-inch diameter) electric cooking-plate, which we learn is "the electrical equivalent of the spirit lamp and the gas-ring without their disadvantages," will boil 1 pint of water in eight minutes! Pity the user! We find it stated that with this plate, a unit of electricity will boil about 12 pints of water, or 15 lbs., "if a satisfactory flat-bottom saucepan be used." Calculating this out on the theoretical basis, the claim is for an efficiency of nearly 70 per cent. Now is this claimed efficiency consonant with the truth? It is not the efficiency found by other experimenters with similar plates and the truest of flat-bottomed utensils. Heating elements will deteriorate—in kettles, hot-plates, and other things; and we challenge the G.E.C. to prove that the efficiencies they claim for the two pieces of apparatus referred to here are obtained when new and throughout the twelve months over which the articles are guaranteed. The information given in connection with the other articles cannot be tested in the same way. Regarding the fires, the booklet claims that those suitable for heating a room 12 feet square (at 1d. per unit) will cost 1½d. an hour; those suitable for heating a room 16 feet square, 2d. per hour; and those suitable for a room 18 feet square, 3d. per hour. Have the Company worked these statements out to see how they comply with the requirements of some electrical engineers for 1½ watts per hour per cubic foot of room capacity? Even if they have not, they cannot, on their own figures, fairly claim that the "Magnet" electric-fires meet the statements in the "Foreword" as to economy.

Croydon Experiences and Wants.

In most of the populous districts of the country, gas and electricity supplies, despite keen competition, make progress year by year; but the gas business is so much bound up with trading in other directions—mainly through secondary products the markets for which are inclined to see-saw more than is at times quite pleasant—that the financial results as between gas and electricity have no comparable or common foundation. The Croydon Gas Company is a concern that progresses luxuriantly, with the result that new works have to be erected, and money spent in keeping pace with the requirements of the large area. Nevertheless for last year the Corporation Electrical Engineer (Mr. Alex. C. Cramb) reports an increase of nearly 600 new connections, and an additional sale of upwards of 700,000 units of electricity. The 600 new connections are referred to in one electrical paper as a "remarkable" increase. Among other points, Mr. Cramb reports that the cooking and heating demand has gone ahead by 50 per cent. To obtain some notion as to the true value of the 50 per cent., it is necessary to know what was the total consumption for "cooking and heating" upon which the percentage increase is based. Evidently Mr. Cramb is not satisfied with the total figure, seeing that, in his opinion, the "large field" for the development of the sale of electrical energy for cooking purposes in the borough at the present time is "almost dormant." In view of this, he strongly advises the Corporation to take steps to obtain the necessary parliamentary sanction, without further delay, to hire and hire-purchase electrical apparatus, leaving other matters to be dealt with by the Bill which is being promoted by the Municipal Electrical Association. Parliamentary sanction to business of this sort does not appear to be a matter that can be obtained with certainty for the mere asking. There are a number of interests involved; and municipal speculation through increased opposition to it loses ground annually. In view, too, of the high initial price and maintenance costs of electrical appliances, and the low price at which electrical energy must be sold for baking, boiling, &c., the hire-purchase system should receive preference rather than the hiring-out one—for obvious financial reasons. Parliament will no doubt, if Mr. Cramb's advice is adopted, take steps to ensure that there is adherence to the rule of the model clauses, that the income on the fittings supply business shall at least equal the outgoings. As to the Municipal Electrical Bill, its chances of becoming law do not look any brighter than since its first introduction; and Parliament is far too busy with its social legislation and with the distribution of "rare and refreshing fruits" to give up time to further municipal electrical speculation.

The Old Story, and New Uses.

A great deal of attention has lately been given to the question of electrically propelled vehicles; the charging of accumulators being a new form of custom for electric supply stations. The manufacturers of electric-light fittings have also been paying attention to lighting equipments for cars. It is a business with which the gas industry is not competitively concerned, but there is interest in it on account of the experiences of users of electricity for car lighting being so similar to those of users for the lighting of premises that are stationary and not on wheels. An article on the danger of electric lighting for cars has appeared in the "Motor." The system is referred to as very nice and convenient; but "there is one danger attendant upon its use which must not be lost sight of—viz., that if a connection comes adrift or a fuse 'goes,' the light goes out." The old common weakness of electricity as a lighting agent! This is not pleasant especially if one happens to be travelling fast. Three friends of the writer of the article told him, at the recent Olympia Show, that the trouble had occurred to them. One of them, being left suddenly in the dark through the failure of the car's electric light, ran the car into a ditch before he could stop; and the other two said their experiences were such hair-raising ones that they certainly did not want to go through them again. A big smash might easily have happened in any of these cases. Stand-by oil or acetylene-gas lamps are advised, or double batteries, so that both head-lights are not dependent on one source. In America a combination gas and electric head-light is now largely used for cars—each lamp being a combination of four lamps in a single casing. The lamp is divided into two compartments; the top one containing an acetylene-gas jet, and the lower one an electric bulb, with two small electric bulb lamps on either side for use when the car is standing still. The lights can all be worked from the seat; and this gives a control which is very necessary in some places in America where, as in Chicago, the regulations compel the elimination of brilliant head lights in city streets—the electric lights being switched off, and the gas-jets reduced to quite small proportions. In the House of Commons recently, a question was asked as to the use of dangerously brilliant head lights; and it would be a good thing if something were done to protect the public from them here. After motor cars, perhaps low-hanging shop lamps of high intrinsic brilliancy could be dealt with.

Attractiveness of High-Pressure Lighting.

The current number of the "Illuminating Engineer" contains a paper by Mr. C. F. Lacombe, the Chief Engineer of Light and Power in the City of New York, read before a joint meeting of the American Illuminating Engineering Society and the Municipal Art Society, on the subject of the high-intensity lighting of European cities compared with New York. In the course of it he expresses the opinion that, with the improvements made in the past five years, high-pressure gas lighting has become a decided competitor with electric lighting. When using the term "competitor," however, he says it should be qualified by this statement: "The successful use of the high-pressure lamp depends largely on the excellence of its maintenance. From the whiteness of the light afforded when well maintained, it gives an effect of brilliance to a street illuminated by this system that is very attractive—more so than the yellow-flame arc lamp used in London and Paris, and equalling that of the nearly white flame lamps of German cities. The yellow-flame lamp, on account of the reflection of its yellow light from dust and moisture particles in the air, gives an effect of denseness that is almost oppressive when compared to the clear brilliance of the high-pressure gas-lamp."

NOTES FROM WESTMINSTER.

The resumption of Committee work, after the brief interruption by the Whitsun Holidays, has only so far brought two or three Gas Bills into prominence; and second House contests are not expected to be many. The Skegness District Council have compelled a further fight over the Skegness Gas Company's Bill; and three sittings up to the close of Friday had been spent hammering out the case, and even then the promoters had not succeeded in reaching the end of their evidence. The Council have been very properly unfortunate in their contests with the Company, in which they have tried to besmirch them as much as possible. They did not succeed in the House of Lords; and now in the House of Commons they have brought in Mr. Wedderburn, K.C., to assist the Hon. J. D. Fitzgerald, K.C. Comment can be deferred until a convenient time after the Committee have given their decision. The Ossett Corporation Bill has been before the section of the Local Legislation Committee over which Mr. Middlebrook presides; and the clauses referring to the calorific standard and testing have been adjusted to the terms of the Gas Light and Coke ones —thus raising the proposed standard of 520 B.Th.U. gross to 540 B.Th.U. gross, with a margin before the penal point is reached of 7½ per cent. The penalties are to follow the Morley ones. The Brentford Gas Company have in their Bill an innocent clause asking for the right to apply to the Board of Trade for electricity supply powers. The Metropolitan Electric Supply Company regard this as a very serious matter—indeed, as the first step towards competition with them. The Electric Supply Company are only in the position to supply in bulk in the area. However, they tried last Thursday to obtain from the Court of Referees *locus* against the Gas Company, but did not succeed. Competition is not a very strong argument in such cases, as has been shown on previous occasions—a notable instance being when the North Metropolitan Electric Power Company, also a bulk supplying concern, sought *locus* against the Tottenham Light, Heat, and Power Company in respect of the Wood Green electricity supply.

WORKS TOPICS.

By "Modus Operandi."

"Venturi" Meters.

The article in the "Journal" for June 9 [p. 707] giving particulars of "Venturi" meters is interesting, as, indeed, is any description of developments in new and useful apparatus. As regards the accuracy of this type of meter, it is encouraging to learn that, working in series with a station meter at the Luton Gas-Works, the margin of error is found to be no more than 1 per cent., which must be considered a very creditable achievement. There is one point, however, which does not appear to be touched upon in this article, and that is the amount of back-pressure thrown by these meters. At first sight this might be expected to be excessive; but as this detail of working has been well tested in practice, I should be glad to know whether or not this is the case. The cost is again an important point on which many would wish to hear further. Having regard to the undoubted difficulties of solving so complex a problem as the accurate measurement of fluids and gases on such a principle, one cannot but admire the ingenuity of those responsible for its development.

Water-Gas Plant.

The possibility of working a carburetted water-gas plant in conjunction with the coal-gas plant without the use of a relief holder has doubtless been considered on many occasions. Should any reader have experience of such a method of working, it would be of general interest for publication; for there would be, in some works, considerable advantage in mixing the gases at an early stage in the process. There is a distinct probability that some portion at least of the hydrocarbons in the carburetted water gas would be picked up by the coal gas, instead of being condensed out as tar. The fact that a vacuum is maintained in the coal-gas plant until the gas reaches the exhauster suggests that there would be no difficulty in admitting the carburetted water gas as made, instead of passing it into a relief holder. Considerably less back-pressure would be thrown upon the carburetted water-gas plant, which is in itself an advantage. There is no doubt, too, that an exhauster fitted with a reliable governor would accommodate itself with perfectly satisfactory results to the intermittent flow of gas from the carburetted water-gas plant.

It is again extremely likely that the effect of passing the water gas through the coal gas washing and scrubbing plant would have the effect of ridding this gas of the tar-fog which is almost invariably most troublesome, and which so often has the effect of ruining the oxide used in the carburetted water-gas purifiers. By passing the carburetted water gas through the coal gas washers and scrubbers, in addition to those attached to its own plant, the carburetted water gas would receive a very thorough scrubbing, which is by no means the case in the process as generally arranged. In fact, the net result of working in this way would probably be of very substantial benefit in actual results, while it is more than possible that the intimate contact of water-gas tar and coal gas throughout some considerable part of the process would have a very desirable effect on naphthalene difficulties.

The above opinions are purely problematical, and are not based on any practical experiments in this direction; but it is quite possible that some reader has had experience of such a method of working, in which case the results would be most enlightening.

Testing Gasholder Lifts.

Yet again the excellent idea of testing the working of gasholder lifts by means of pressure recording apparatus is receiving further commendation. In the "Journal" for June 9 [p. 716], Mr. W. C. Jackson, in his paper to the Wales and Monmouthshire Institution, shows most conclusively the necessity of testing holders by this method. It is not difficult to foresee that there will be a general adoption of this idea for adjusting the rollers on gasholders.

NOTES FROM ABROAD.

Canadian Gas Association.

A meeting was held recently of the Executive of the Canadian Gas Association, when it was decided to hold the annual meeting this year on Sept. 3 and 4, instead of June 11 and 12, as previously arranged and announced. The meeting is to be held at Ottawa. Full details have not yet been settled.

New Home Application of Gas.

The Superintendent of the Scranton (Pennsylvania) Gas and Water Company has aroused great interest locally by a suggestion in the Press for solving the problem of how to be rid of the disease-carrying common fly. He proposes that gas-operated household incinerators should be installed for the destruction of all refuse, which, he considers, would go a long way towards eradicating the pest.

Gas in Porto Rico.

Prosperity is reported from the Porto Rico Gas Company, which at present has some 3000 consumers. By the end of the year it is expected this number will be almost doubled, if the present rate of increase is maintained. A certain amount of public lighting is being done, but shop lighting is not very profitable, since the shops only keep open on Saturday evenings. The most profitable field seems to be cooking, and a dozen natives have been trained to call at the houses and demonstrate the uses of gas. This plan is proving very successful.

New Business Methods.

In a paper on this subject read at a recent meeting of the Pennsylvania Gas Association, Mr. E. M. Stack, of Scranton, stated that he had put out thousands of gas-ranges on a free trial basis, with an option to the consumers to purchase them at the end of the trial period. He had had to remove less than 1 per cent. of them. This seems ample justification for the policy he advocates, which he recommends should also be applied to water-heaters and other gas consuming appliances, and his enterprise must have been very profitable to the Scranton Gas and Water Company.

Gas Supply of Madrid.

From additional particulars furnished by the "Journal de l'Eclairage au Gaz" we learn that the new contract with the Madrid Gas Lighting and Heating Company, to which reference was made in the "Journal" for the 2nd inst. (p. 636), has been signed, and will run for twenty years from the 21st inst.; but it will be terminable at the end of twelve, fifteen, or eighteen years on six months' notice being given to the Company. It appears that at the eleventh hour the Electric Light Company offered to undertake the supply at a reduction of 20 per cent. on the Gas Company's figures; but this was declined, and the contract was unanimously approved without alteration.

Sulphate of Ammonia in Russia.

The "Chemical Trade Journal" states that the Russian Government is at present devoting considerable attention to the use of peat and fuel, and an important part of the scheme is the recovery of ammonia for making sulphate. The large peat resources of the country are mostly situated far inland; so that the cost of carriage would prevent the products from being exported. It is quite possible that this increased production of sulphate might have a good effect on the market. The Russian farmer is so notoriously indifferent to the merits of ammonium sulphate, that any additional quantity produced would have to be sold at low prices at first. In this way its advantages might become known, and a considerable increase in the demand from agricultural Russia would be very welcome.

Gas in Motor Car Manufacture.

The June number of "Gas Logic" contains some interesting details as to six large gas ovens which are used by the Ford Company in Long Island City for the baking and japanning of motor car bodies. The ovens are 19 feet by 9 feet by 7 feet high. A body is completely painted by means of a spraying machine in from two to three minutes, and receives three coats. After each painting it is baked for forty-five minutes to an hour in one of the gas ovens, at 155° Fahr. the first time and 175° Fahr. the other two. In this way 180 bodies are baked every day. The ovens open at both ends, and as soon as two or three bodies are ready, they are put in, and the others, which are partly baked, are pushed along, to be taken out in due course. The heat lost by the opening of the doors is compensated by the time saved by this method.

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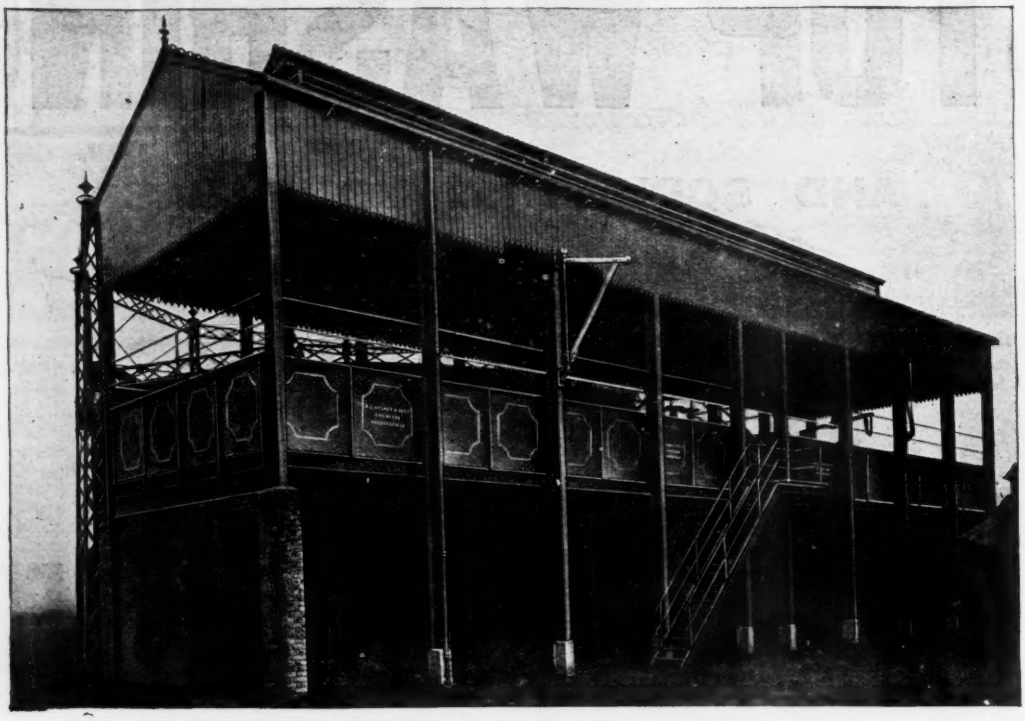

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BRIDGE LIGHTING BY HIGH-PRESSURE LAMPS.

LIGHTING OF THE NEW ROCHESTER BRIDGE.

THE accompanying view is a photograph of the new Rochester Bridge, recently opened by Lady Darnley. The photograph was taken after dark, and it shows the extraordinarily good illumination of the bridge by the "Keith" light, supplied and fitted by the James Keith and Blackman Company, Limited, under the supervision of Mr. C. Valon Bennett, the Engineer and General Manager to the Rochester, Chatham, and Gillingham Gas Company.

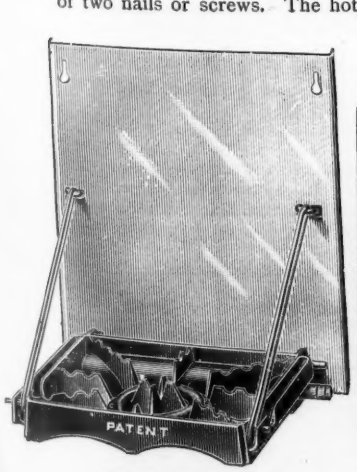
The compressor, which is one of the Keith patent rotary pattern, is driven by an electric motor, and has a capacity of 1000 cubic feet per hour. There are 63 lamps employed, each of 500-candle power; 34 of them being suspension lamps, and 29 on columns. Excellent as the photograph is, the lighting itself has to be seen to be appreciated; and bearing in mind the economy of the lighting, the Contractors consider that it is one of the finest pieces of illumination they have carried out.

It is also interesting to note in this connection that Messrs. Keith and Blackman have just supplied an installation for the lighting of the Tower Bridge, which the South Metropolitan and Commercial Gas Companies are jointly fitting up.

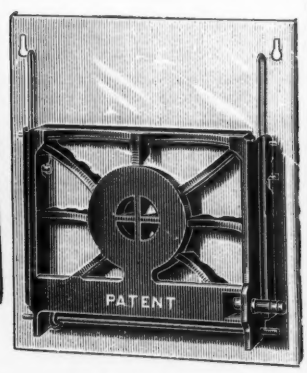
HULETT'S COLLAPSIBLE GAS-STOVE.

POSITIONS will occur to one—such as tiny sculleries, flats, &c.—where it would be difficult to find room for a small gas-cooker, or even a griller, and yet where provision for accomplishing boiling, frying, toasting, and similar operations, without trouble would be warmly welcomed. In fact, it is precisely to fill such a want that Messrs. D. Hulett and Co., Limited, of Nos. 55 and 56, High Holborn, W.C., have introduced their patent collapsible gas-stove. That they have been successful may be assumed from the statement that in many cases sample orders have been followed by others. For gas undertakings abroad, too, the ease with which the appliances can be packed for shipment is another point in their favour.

The illustrations show the apparatus both open and closed; and it will be seen that the idea is simplicity itself. There is a white enamelled steel back plate, to which the hot plate (provided with an efficient ring-burner) is attached. When open, the stove is supported by two long links; and when it is done with, it is pushed flat up against the back plate, where it is held by dropping the links into channels at the sides. To open, all that is necessary is to draw up the two links, when the stove falls into position. The gas connection is provided by flexible metallic tubing; and the arrangement is attached to the wall by means of two nails or screws. The hot plate is cast in one piece; and there is nothing for dust, &c., to settle upon. In connection with the enamelled plate, it should be pointed out that the edges are turned back, so as to give a space of half-an-inch between the plate and the wall, and prevent the wall from getting too much heated. The appliance, which occupies a depth of only 2½ inches when folded up, is made in two sizes. In one of these, the stove is 10 inches wide, by 8 inches from back to front; in the other, 11 inches wide, by 9 inches from back to front.



The Stove Open.



Folded Up against the Back Plate.

The idea really arose out of the firm's well-known meter-shelf bracket, which was noticed some time ago in our pages, and of which some 50,000 have already been disposed of. The meter-shelf is made out of one piece of sheet iron, and is attached to the wall in a similar manner to the stove. Photographs have been taken of a shelf successfully withstanding a weight of 1½ cwt., with the nails in the cement between two rows of bricks; and these effectually dispose of any possible doubt that might arise as to the ability of the stove suspended from a wall to bear any weight that would likely be placed on it. In their collapsible stove, Messrs. Hulett and Co. have an article which should prove very useful in cramped positions.

Estimation of Carbon Monoxide.—At a recent meeting of the Chemical Society, this subject was dealt with by Messrs. J. T. Graham and T. F. Winmill. As is well known, carbon monoxide is oxidized to carbon dioxide by iodine pentoxide; and various methods of estimating it have been described, based on this reaction. The authors have studied the temperature at which the reaction takes place, and the influence of other gases on its course. A modified form of Haldane's gas-analysis apparatus was described, in which the oxidation may be carried out rapidly, and carbon monoxide estimated with an accuracy of 0·02 per cent.

Kent's "Venturi" Gas-Meters.—With reference to the remarks made on p. 708 of last week's "JOURNAL" as to "Venturi" meters and the measurement of dirty gas, Messrs. George Kent, Limited, write: "While by its nature, and the absence of any working parts in the pipe-line, the 'Venturi' meter is less affected by dirty gas than are other types of gas-meters, extreme accuracy is liable to be somewhat interfered with by the presence of tar, naphthalene, or other similar impurities in considerable quantities. It is therefore desirable that meters should, if possible, be so placed that the gas is purified before being passed through the 'Venturi' tube. But where this cannot be arranged, provision is made whereby the throat-piece of the 'Venturi' tube can be instantaneously changed, to permit of the insertion of a second throat and the removal of the throat previously in operation, so that it can be wiped out and be ready in its turn to be used again. The prevention of deposits of naphthalene can be secured by keeping the throat warm by a steam coil or other convenient means."

THE TREATMENT OF PREPAYMENT CONSUMERS IN HOLLAND.

By D. Stavorinus, Amsterdam Municipal Gas-Works.

The internationality of the gas industry brings with it the natural consequence that a paper such as that of Mr. Carter on the treatment of prepayment consumers [see "Journal," April 28, p. 262], has also caused a great deal of interest on this side of the Channel. No wonder, for in Holland the prepayment system is of such extensive use, that in some towns the slot meters considerably outnumber the ordinaries. As usual, the prepayment consumers are charged some additional pennies on the ordinary gas price. Why not? Is the gas industry a philanthropic institution, that those who enjoy its advantages need not pay for them? And now Mr. Carter is telling us that a powerful and opulent industry, as the gas industry certainly is, singles out the prepayment consumer for exceptional and unfair treatment. How is that? Are not our calculations such as to fully justify this almost trifling extra charge? Our conviction was that we were treating the prepayment consumer in a fair way and to his entire satisfaction.

To show that this is the case at any rate in Holland, let us consider how we treat the prepayment consumer, and what we give him for the extra charge on the gas price. In Amsterdam a slot-meter installation consists of a prepayment meter, free house piping to the maximum length of 83 feet, two boiling rings, and three lighting burners, with one pendant and two brackets. A prepayment consumer may use further gas appliances of his own, and then at his request there are made extensions to his house piping. These extensions are free of installation costs so long as the total length of the piping does not exceed the allowed 83 feet. In case the total length is more than this, the consumer has to pay in advance the cost of material and wages for fitting the extra length. Up to now the slot meters are almost all halfpenny meters, as is generally the case in Holland. The price of gas for ordinary meters is 7 cents, and for slot meters 7½ cents per cubic metre, which is equivalent to 3s. 3½d. and 3s. 6d. per 1000 cubic feet. So the extra charge for the prepayment gas is 2⅝d. per 1000 cubic feet, and therefore only a trifle more than in Lincoln. But when we go to the root of the matter, the extra charge in Amsterdam is almost theoretical. An ordinary gas consumer has to pay for the use of his meter a monthly rent, and for a five-light meter the amount is 4d. monthly, or 4s. yearly. On the contrary, a prepayment consumer is free of meter rent; but instead of this he has to consume a fixed minimum quantity of gas—viz., 500 cubic metres, or 17,500 cubic feet yearly. For this quantity of gas the extra charge on the price amounts to 4s. 2d. per annum, or only 2d. more than the meter rent for an ordinary consumer. When his yearly consumption does not reach this figure, he has to pay as many half-cents as the number of his consumed cubic metres is below the fixed 500. That is to say, a prepayment consumer has in any case to pay an extra charge of 4s. 2d., be it in gas or in cash. There is certainly no objection to this business method, as it is only 2d. per annum higher than an ordinary consumer has to pay as meter rent. Only when his yearly consumption considerably exceeds the fixed minimum is he at a disadvantage.

Now some account must be given of the cost of collecting. In Holland the custom is that the meter inspector comes every month, and that ordinary consumers pay monthly for the gas consumed in the foregoing month. The bill is presented twice, and then, in case of non-payment, the consumer gets a summons to pay within a few days. If he is still unwilling, the supply is cut off, and he cannot obtain gas before he has fully paid his bill, and also 2s. 6d. and 4s. 2d. for the extra costs. For the slot meters there are special collectors. Every collector has an assistant to carry his money bags. They empty the boxes, count the money in the presence of the consumer or one of his household, compare the amount with the number of coins registered by the meter totalisator, and read the meter index. The figures are entered in a notebook, where there is a folio for each consumer, and the same figures are noted on a card connected with the meter. As the money is counted *in loco*, false coins, &c., are directly returned to the consumer, who has to replace them by good ones. Returning to head-quarters, the total amount brought in by every collector is checked-over in the usual manner. The further treatment of the coins proceeds mechanically. Some of the halfpennies are delivered in numbers of 400 into linen bags. The greater number are dealt with by a mechanical apparatus, which first sorts out the damaged coins, and then makes rolls of forty coins each—a roll being therefore one Dutch florin (2od.). For the supervision of this only one girl is needed, and this is sufficient for the whole quantity of 113,028,381 halfpennies a year (in 1912).

This system of collecting certainly involves additional cost; and when we make up the accounts for the ordinary consumers and for the prepayment consumers, the result is that the net profit per 1000 cubic feet is less with the slot meters than with the ordinaries, and even with an extra 2⅝d. per 1000 cubic feet for prepayment gas, the consumers get a bonus at the expense of the undertaking. I will try to explain this with some figures. I have at hand a report made in the year 1911, in which year one of the councillors proposed to drop the extra charge for the slot system, and to have an equal gas price for both systems. As already explained, this was really the case, as the extra charge in the slot system equals the meter rent in the ordinary system. But a special report was made which showed by actual figures that the proposition was quite unfair to the ordinary consumers. The figures are from the report of the service in 1909, in which year there were 59,868 slot meters and 44,330 ordinaries.

The extra distribution costs beginning at the meter-inlet are as follows:

Slot Meters.

	£ s. d.	£ s. d.
Inspecting and collecting		2,082 6 6
Changes		5,863 9 7
Distribution costs		1,086 18 7
Maintenance of meters	1,084 7 6	5,247 6 3
,, piping and appliances	4,162 18 9	
Interest on capital outlay meters	4,030 8 11	8,394 2 1
,, piping and appliances	4,363 13 2	
Depreciation of meters	5,776 1 4	10,562 2 6
,, piping and appliances	4,786 1 2	
		33,237 0 10
Restitutions		1,167 0 6
		32,070 0 4
Extra charge 30,959,854 cub. metres.		12,899 18 9
Loss		19,170 1 7

on 1,083,595,000 cubic feet of prepayment gas.

Ordinary Meters.

	£ s. d.
Inspecting and collecting	3,475 12 6
Changes	1,269 1 8
Distribution costs	31 16 8
Maintenance of meters	2,188 7 4
Interest on capital outlay meters	1,662 4 11
Depreciation of meters	3,439 10 0
Total	12,066 13 1
Restitutions	14 10 10
Total	12,052 2 3
Meter rent	10,763 6 4
Loss	1,288 15 11

on 49,870,000 cubic metres, or 1,745,457,500 cubic feet, ordinary gas.

From these figures it is seen that in the year 1909 the extra distribution costs for the slot-meter system were 3s. 6⅝d. per 10,000 cubic feet, as against 1⅛d. per 10,000 cubic feet with ordinary meters, and averaged 6s. 4⅜d. per slot meter, as against 7d. per ordinary meter. Calculated in another way, we get as the net revenue in the prepayment system 2s. 11d., and in the ordinary meter system 3s. 3d. per 1000 cubic feet of gas sold. Therefore, for the slot-meter system to be self-supporting, the extra charge of 2⅝d. per 1000 cubic feet is totally inadequate to counterbalance the extra expenditure, and the extra charge ought to be at least doubled. The sum of nearly £20,000 shown in the table is charged to general expenditure, and every prepayment consumer gets a yearly bonus of 6s. at the cost of the gas-works. This is certainly not unfair treatment.

These figures for the year 1909 can with no appreciable difference be applied to 1912. In that year the number of slot-meters had risen to 70,008, as against 48,514 ordinaries; the prepayment gas being 41·65 per cent. of the total gas sold; and an average of 18,830 cubic feet per slot meter. The same result as in Amsterdam is to be found in other Dutch towns, as shown by the 1912 figures, for instance, for Haarlem and The Hague. Haarlem has 6749 ordinary and 7471 slot meters. The average consumption per slot meter is 14,000 cubic feet, and the greatest consumption registered by one slot meter 53,788 cubic feet. The extra cost of distribution in the slot meter after the deduction of all benefits amounts to £903 3s. 7d.—*i.e.*, 2s. 6d. per slot meter, and 1s. 4⅛d. per 10,000 cubic feet of gas. But the gas prices are 3s. 3½d. for ordinary, and 3s. 8⅛d. for prepayment gas, so the extra charge in this case is 5⅜d. per 1000 cubic feet, which is still inadequate to counterbalance the extra expenses. In The Hague the price of gas is 2s. 9⅜d. per 1000 cubic feet for ordinary meters, and 3s. 0⅛d. for slots—a difference of 2⅝d.—just as in Amsterdam. The loss on the exploitation of slot meters for a quantity of 277 million cubic feet of gas sold to prepayment consumers has been £3142—*i.e.*, 2s. 3d. per 10,000 cubic feet.

In all these cases, the gas undertaking, be it municipal or company, profits more by selling gas through ordinary meters than by distribution in prepayment meters. And in all cases the prepayment consumer gets for his money more benefits than the ordinary consumer. So the gas industry need not fear the awaking of sleeping dogs, for, as they are generally well-treated, they are not likely to bite.

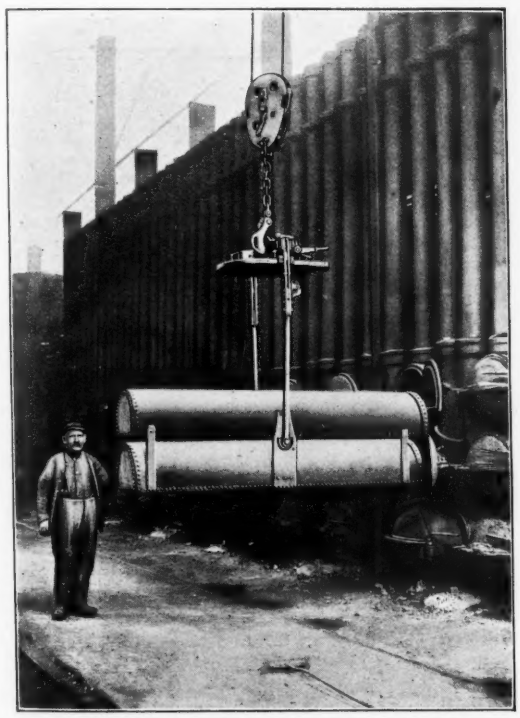
According to the "Electrical Review," an official report which has lately been issued in Germany shows that gas was responsible last year for 413 accidents, resulting in the death of 134 persons, serious injury to 335 people, and slight injuries to 76. As regards electricity, there were 251 accidents during the year, in which no fewer than 147 persons, including 74 employed at central stations, were killed, 71 badly injured, and 10 slightly so. It will be noticed that, though the gas industry in Germany exceeds in the magnitude of its business the electrical industry, the number of fatalities were less in it than in the latter.

THE "DRYCO" SYSTEM OF COKE COOLING.

REFERENCE is made, both in the course of Mr. Edward Allen's Presidential Address to the Institution of Gas Engineers and in the description of the Liverpool Gas-Works to the system of cooling coke without contact with water, which is in successful operation in the city, working in connection with horizontal retorts. The system—which has been named the "Dryco"—is in accordance with Messrs. Allen and Gibson's patent; and from Messrs. Aldridge and Ranken, of No. 39, Victoria Street, S.W. (the sole licensees for the apparatus), we have received the following additional particulars, as well as the accompanying illustrations.

A steel container (consisting of two parallel vessels strapped together, one above the other, of the same section as the retorts to be discharged, each one-half of the length of the retort) is suspended from an overhead telpher or transporter. This runs the whole length of the retort-house. The container is brought into position before the retort in a horizontal position. Its open end is placed against the open retort, and one-half of the charge of coke pushed into the container by the Fiddes-Aldridge or other suitable stoking machine.

The container is then raised, and the other half is similarly filled. It then swings into a vertical position, and a lid automatically and quickly closes the end of the container. This is then transported by the telpher, lowered into a water-tank, and detached. The coke being contained in a closed water-tight vessel,

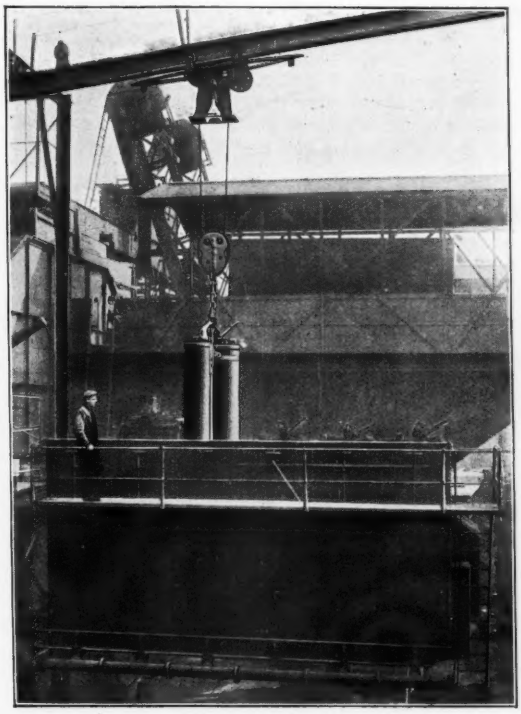


"Dryco" Container in Position before the Retort-Bench, ready for Charging.

neither water nor air has access to it during the period of cooling; but the water in the tank circulates around the container. In about three-quarters-of-an-hour the coke is cooled. The container is then lifted by the telpher, and taken to the coke-store and discharged.

In the interval between the placing of the container in the tank and its removal to the coke-store, the telpher has filled, transported, and immersed several other containers, going through the cycle of operations: (1) Filling with coke. (2) Cooling in tank. (3) Discharging in coke-store. It is estimated at Liverpool that to ensure a rapid service, one container is required for about every nine retorts of 20 feet length. In smaller works, this can be reduced.

By means of the "Dryco" system, the coke is absolutely dry, very large, almost free from breeze, and is of a bright silvery grey colour. It commands a higher price for household and industrial use than ordinary wet coke, through its greater heating value, and has been used for foundry work with encouraging results. Large castings have been satisfactorily made from a cupola heated by "Dryco." It is suitable for many purposes for which the more expensive furnace and foundry cokes are now employed. The cost of handling is low; and as the coke is quickly removed in closed vessels, there is practically no flame, smoke, steam, or dust. By extending the overhead telpher-track, the coke can be quickly and cheaply discharged on to a coke-heap, into hoppers (with or without a breaker or screen), or direct into railway-trucks or carts, with little manual labour.



"Dryco" Container being Lowered into the Cooling Tank.

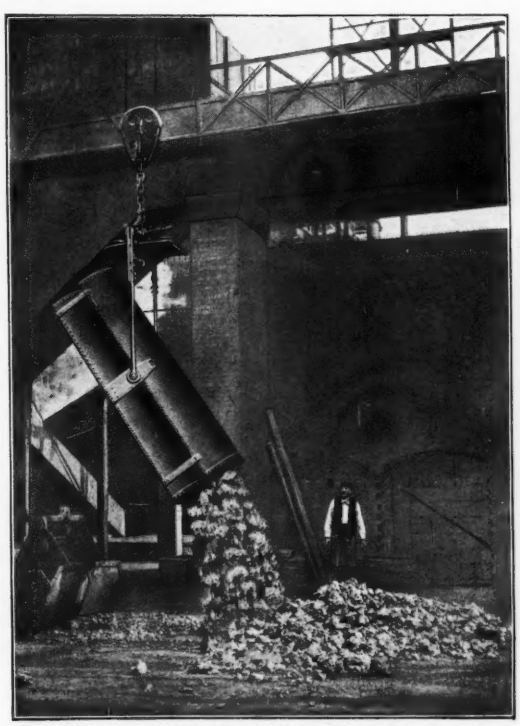
The following are the advantages which are claimed to be obtained by producing "Dryco" instead of gas coke.

1.—*Satisfaction of Customers.*—This is owing to the improved quality and higher calorific value. The high calorific value of "Dryco" is mainly due to the absence of moisture, and may be taken as about 13,000 B.Th.U. per pound, varying with the class of coal used. The effect of 10 per cent. of moisture in the fuel may be seen from the following calculations:—

	B.Th.U.
Heating power of 90 lbs. of dry fuel at 13,000 B.Th.U. per pound	1,170,000
Heating power of 10 lbs. water	*Nil*
Heat required to evaporate the 10 lbs. of water	11,180
Actual heating power of 100 lbs. of moist fuel	1,158,820
Actual heating power of 100 lbs. of "Dryco"	1,300,000
Gain in heating power by using "Dryco"	141,180

Equals 12·19 per cent.

2.—*Better Price Obtained.*—From the above, it will be seen that the calorific value of gas coke containing 10 per cent. of moisture, compared with "Dryco," is as 100 to 112·19. Taking



"Dryco" Container Automatically Discharging.

the yard price of ordinary coke at 15s., then the comparative value of "Dryco" would be 16s. 9½d., or an increased value to the customer of 1s. 9½d. a ton. There is also the better value due to the physical conditions of "Dryco," its better burning qualities, and the saving in carriage. "Dryco" burns quietly, and does not crackle or fly when placed on an open fire, owing to the absence of moisture. It contains very little "small" or dust, as by this process breakage by conveying machinery and repeated falls is reduced to a minimum, while disintegration and softening through the application of water and steam are entirely avoided. "Dryco" is harder and larger in size than gas coke.

3.—*Economy in Working Costs.*—By the adoption of the "Dryco" system, a considerable saving is effected. There is practically no breeze produced, screening is unnecessary, and "quenching" is done automatically. The economy will be seen from the following figures:—

	Old System. Per Ton.		"Dryco" System. Per Ton.
Loss due to breeze (say) 10 per cent.—0·10 ton at 9s. (15s. less 6s.)	10·8d.	..	*Nil*
Cost of screening (including power and labour and maintenance (also depreciation) per ton	3·15d.	..	*Nil*
Water for quenching (this charge is for circulating the cooling water in the "Dryco" system and for the water thrown over the coke in the old system)	1d.	..	1d.
	14·95d.	..	1d.

The above statement shows a saving in favour of the "Dryco" system of (say) 1s. 2d. per ton. This saving is to a small extent discounted by the fact that under the old system the buyer pays for moisture at the price of coke; this varying according to the amount of moisture in the coke. For instance, if 15s. were the price obtained for a ton of coke containing 5 per cent. of moisture, then to obtain the same return coke containing no moisture should be charged at 15s. 9½d. per ton. The comparison given shows that "Dryco" could be sold at a less price than gas coke, and still yield a better return, though, being of great value, a higher price might easily be obtained.

4.—*Saving on Carriage.*—As one ton of "Dryco" is of much higher value as a fuel than ordinary gas coke, it naturally follows "Dryco" will cost less in carriage for equal heating value.

5.—*Quality is Uniform.*—As "Dryco" contains no moisture, and is not damaged in manufacture, it is more uniform in quality than ordinary coke, which is known to vary very considerably in the amount of water it contains and in its physical condition.

6.—*No Choking of Drains by Coke Dust.*—The water used in cooling does not come in contact with the coke, and is as clean after use as before.

7.—*Conservation of the Heat.*—The heat in the "Dryco" is transferred to the cooling water; and the latter may be used for boiler feeding, producers, or any other purpose for which warm water is required, as it is in no way contaminated.

8.—*Flame, Smoke, Steam, and Dust avoided in the Retort-House.*—As the "Dryco" is removed in closed vessels, the clouds of steam, smoke, coke-dust, and flame, as well as the intense heat, always associated with the open system of quenching by water, are all avoided.

This system (which is fully protected by patents in England and abroad) can be applied to either large or small works with satisfactory results; and a "Dryco" plant is capable of extension at any time without interfering with existing plant.

TELPHERAGE COKE-CONVEYING PLANT AT LIVERPOOL.

In connection with the description of the Liverpool Gas-Works appearing on another page of this issue, mention is made of a mono-rail telpherage coke-conveying plant, some additional information regarding which (with illustrations) have been forwarded by the makers of the plant—Messrs. Strachan and Henshaw, Limited, of Bristol.

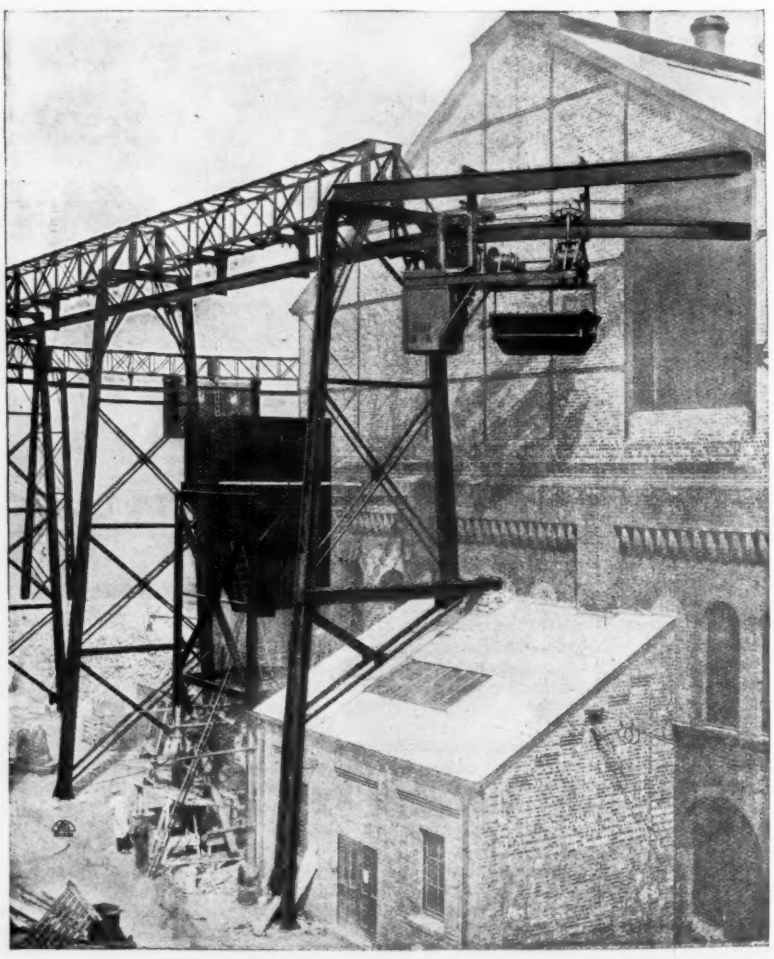
The telpher-track runs through the retort-house—turning at one end over a hopper for feeding the producers, and is carried on, finishing at present in a semi-circular sweep over the coke-stacking ground. In the near future, the track will be continued so as to connect-up to the track at the end of the finished retort-house—in this way making a complete circuit.

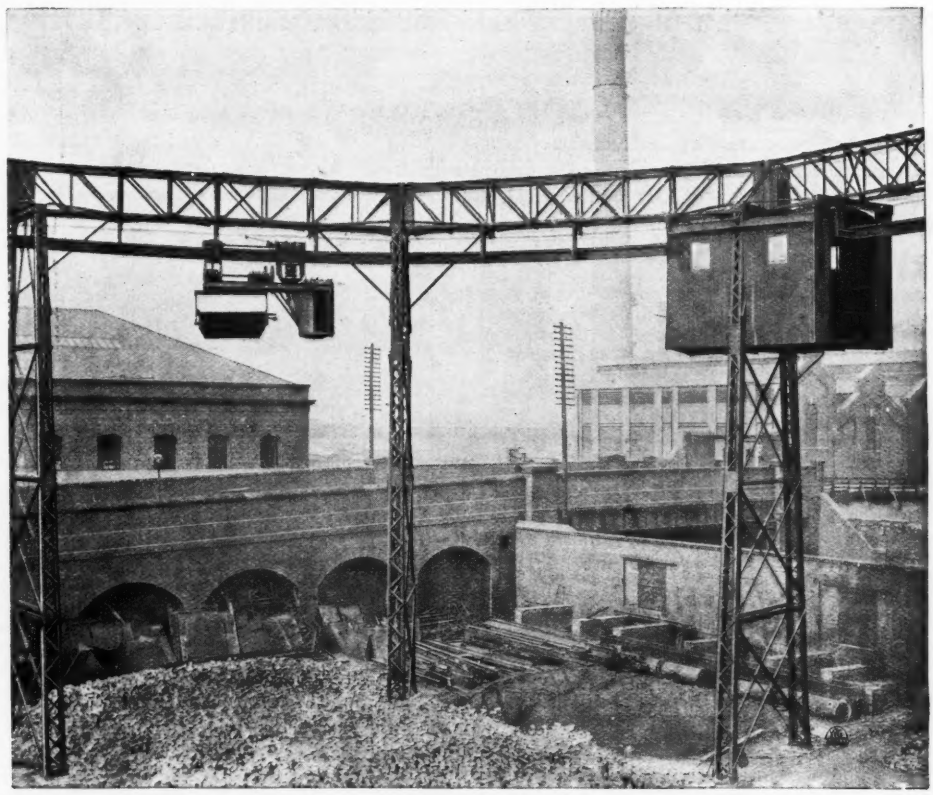
Steel skips, capable of ready attachment to the telpher machines, are placed on the floor below the retort mouthpieces, and receive the coke direct at the regular discharge intervals. Each loaded skip, which is mounted on a roller-bearing carriage, so as to be easy running, is then pushed out from under the retorts till it stands directly under the telpher machine, which lifts the skip from its trolley and carries it to any desired point in the coke yard, or discharges the skip into the hopper supplying the producers. The telpher then returns to the retort-house with the empty skip, to pick up the next full one.

The telphers are of Messrs. Strachan and Henshaw's well-known high-speed type, with free-swivelling wheel bogies capable of negotiating sharp curves. Each wheel truck—of which there are two—pivots independently of the other, and is connected to the main frame through the medium of a perfectly free, universal swivelling, stirrup. This connection has special features. The load is not supported in any way by tension pins or bolts, but directly by the forged steel stirrups. Perfectly easy running with a very small—almost negligible—power consumption is assured by this system; and the machines have a quick acceleration, which is an important advantage. The machines are all guaranteed to develop a travelling speed of 500 feet per minute; but much higher speeds can be obtained when necessary, and particularly on a long and fairly straight run.

The skips are suspended direct from the two lifting barrels, which are placed upon a common axis parallel to the track; the object of the direct lift being to increase the efficiency and save wear and tear on the ropes. All the gear is of steel and machine cut; the barrels being of cast iron turned and grooved for the ropes. The gross hoisting capacity of each machine is 40 cwt. at a speed of 65 feet per minute.

The main frame and driving carriage of the machine are built of mild steel throughout. One end of the main frame is supported by the driving carriage; the other end being suspended by a solid steel forging. An automatic brake is fitted to the hoist gear, which will immediately arrest the load and sustain it when the current is cut off by the operator, or should it fail through any cause. A hand control is also provided for lowering the load by gravity. A travelling brake is operated by the driver with his





foot; and safeguards are provided to prevent the machine jumping the rail or over-running the ends of the track.

The track is supported by hangers at intervals of about 15 feet; the supports being close, to give the track ample lateral stiffness. The hangers are suspended from the underside of substantial box-girders, which are arranged in long spans for the purpose of limiting the number of necessary stanchions, and thus keeping the coke yard free of encumbrance as far as possible. The stanchions are each built of four 10-inch channels; each leg being of box lattice construction. The height of the track is 52 feet from the ground level; and it will have a length when complete of about 770 feet. A telpher-house is built on to the structure in the coke yard; and into this the machines may be run for overhauling and repairs.

The current is conducted to the machines by means of a double line of overhead figure-eight trolley wire, from which the current is picked up by two tramway type trolleys. The wire is held up by means of gun-metal clips and insulating bolts, which are mounted in cast-iron brackets having inverted waterproof pockets over each insulator. The current required to drive the machine, per cycle, at the above speeds, on an average run of 300 feet out and return, with a lift of 40 feet, should be about 0·25 B.T.U.

FLAME STANDARDS IN PHOTOMETRY.

By E. B. Rosa and E. C. Crittenden.

[Abstract of a Paper to be Published in the Bulletin of the United States Bureau of Standards.]

Although an agreement has been reached regarding the relative values of the units of light in use in different countries, no one primary photometric standard has been generally adopted by the various governments. In Germany preference is given to the hefner lamp; in England, to the pentane lamp; and in France, to the carcel lamp. Each of these serves in its own country both as the primary standard and as a working standard; but for the photometry of electric lamps, and generally in accurate photometric work, standardized electric incandescent lamps are used in all countries. In America a group of such lamps kept at the Bureau of Standards is considered as a provisional primary standard, serving to maintain the unit until a better primary standard shall have been devised. It is believed that the unit which has been agreed upon can be so maintained with an accuracy considerably above that with which it can be reproduced by reference to any of the so-called reproducible standards at present in use. In other words, the incandescent lamps have really been employed as primary standards; and the flame standards, which logically should play the part of primary standards, have been relegated to a subordinate position.

There is, however, a possibility of an appreciable drift in the value of the unit if there is no photometric standard accurately reproducible from its specifications which is capable of serving as a reliable check upon the electric standards. It has therefore appeared worth while to make a study of the best types of flame-lamps to see how closely they would reproduce in the Bureau laboratory the values adopted by international agreement, and also to find whether their reliability as primary standards could be increased by any changes in construction or in operation.

The present paper discusses at length the effect of atmospheric conditions on the intensity of flames, and gives tables and curves showing the performance of typical lamps. These data are largely taken from an earlier paper ["Transactions of the Illuminating Engineering Society," Vol. V., 1910, p. 753.]

The carcel lamp is by far the least reliable of the three types, and cannot be considered as a competitor for general acceptance. The hefner lamp and the pentane lamp as at present made divide honours. The latter is markedly superior as a practical standard. But individual pentane lamps do not agree; and until lamps can be independently made which shall give the same value, the type can hardly be said to be reproducible. The hefner lamp is so simple in construction that reproduction of lamps is relatively easy. Lamps now made show small differences due to slight departures from mean dimensions; but these differences can be made negligible by more careful construction. Great difficulty is experienced, however, in making accurate comparisons of working standards against hefner lamps, because of the very low intensity (0·9 candle) and the red colour of the flame.

It is believed to be possible to apply the principle of the present pentane lamp in specially made, accurately specified lamps with interchangeable parts, and thus to obtain a closer agreement between lamps. Then by operating the lamps under definite conditions, one should be able to obtain sufficient precision with either the hefner or the pentane lamp to give a valuable check on the electric standards now in use.

The Late Mr. Thomas Newbigging.

The "Manchester City News" last Saturday contained a long "Appreciation" of the late Mr. Thomas Newbigging by Mr. Abraham Stansfield, who was associated with him at the Manchester Literary Club, of which he was the oldest surviving member. The friendship subsisting between the writer and Mr. Newbigging had been unclouded for more than half-a-century. The following appeared recently in the "Glasgow Herald": "Mr. Thomas Newbigging, whose death at Knutsford was announced in our columns the other day, was (says J. W.) once consulted by the Turkish Government regarding the bringing up to date of some gas-works. At first he found the obeisance and salaams of the officials a little embarrassing; but he soon learned to imitate them. He was told that at one of the works he would meet a very able dignitary who stood high in the estimation of his royal master, and was greatly feared by those over whom he was placed. When this dignitary appeared, along with his secretary, both in gorgeous Oriental costume, the bowing and arm-spreading and feet-scraping exceeded all that had gone before. These over, the dignitary wheeled around to his secretary and said: 'That'll dae wi' you, Jock; you can gang noo.' Then he shook hands warmly with his visitor, saying: 'Hoo are ye, Maister Newbiggin'? I'm rale gled to meet ye. Come awa' to the hoose and get your mornin'. I'm frae Paisley.'"

A CRITICAL REVIEW OF FLAMELESS INCANDESCENT SURFACE COMBUSTION.

By H. H. Gray.

We have all of us been interested during the last few years in a patented process of gaseous heating known as "Flameless Incandescent Surface Combustion"—a title well known by reason of an extensive campaign conducted by one of the co-patentees, Professor William A. Bone, F.R.S., who occupies a professorial chair in the Imperial College of Science and Technology, London.

Historical Review.

The phenomena classed under the general title of catalytic or surface combustion seem to have come to the front with work done by Sir Humphry Davy, the brilliant chemist who inspired so much English work on the fascinating subject of combustion. Michael Faraday also was interested in the action of platinum in gaseous catalysis, and, as was usual with his work on any subject, evolved what appears to be, viewed broadly, a not unsatisfactory explanation of the phenomenon. He suggested that during this catalytic (low-temperature) combustion the reacting gases were condensed on the surface; and he compared the process to action under the influence of high pressure. This was clear recognition of what more modern chemists call the influence of "concentration." De la Rive and Döbereiner are other famous names; while in the files of the "Journal of Gas Lighting" is a record of work done on the same subject by Thomas Fletcher—an acute observer and pioneer in practical combustion. A period of quiescence thereupon ensued. The decrees of fate settled that Messrs. Bone and Wheeler should be the instruments in this country through which interest was to be aroused in the fallen fortunes of the subject—a task which was performed by means of an examination into the action of various surfaces on combustible gaseous mixtures at low temperatures (300° to 500° C.). The results were embodied in a communication to the Royal Society.

Abroad there was, of course, a general theoretical interest in the action of surfaces, and we have the work done by Nernst, Bodenstein, and others. Mendeléeff, in his suggestive treatise on "elementary" chemistry (the adjective is his own), never fails to point out the influence of mass and of contact action; his pupils have made valuable contributions to the study of the subject.

All the work so far mentioned, however, is of the philosophical or pure science order. The industrial developments are of later date—having occurred within the last ten years. The names chiefly and most deservedly connected with these later developments are those of Messrs. Bone, M'Court (England), Lucke (America), and Schnabel (Germany). But our interest naturally centres in English work, and apparently with good reason. The English patentees appear to have been the first to grasp the fact that intensified combustion was anything other than merely desirable. So far as the writer has seen details of Lucke's work and patents, they do not seem to be quite so scientifically worked out as do the observations made by the English workers. There is no doubt that from the very first the English pioneers in this work—Bone, M'Court, Wilson, and their helpers—did not commit the mistake of under-estimating the phenomenon that they had unearthed. If anything, their enthusiasm was too great; and the fact that, interesting though flameless incandescent surface combustion can be made, similar results may be differently obtained, does not seem to have been given due consideration. Lucke, in America, appears to have obtained effects without pausing very long to think how. Schnabel, in Germany, may have been quite an independent pioneer; but his patent specifications were very similar to those of the English inventors, and, so far as the writer remembers, did not ante-date them by any important margin.

In England, both Bone and Wheeler seem to have had the idea of applying their research results to technical work; but although they did collaborate in the foundation work, Wheeler does not appear to have taken part in the industrial development. The writer is led to understand, however, that Wheeler did independently attempt to apply his theoretical results to industrial uses, by using fire-clay surfaces to improve the combustion of the gaseous products in a coal-fired boiler. The better known processes were, however, patented under the auspices of the Radiant Heating Syndicate, Limited, of Leeds; and the names of Messrs. Bone and M'Court figuring most prominently in the patent specifications, the process is most often referred to as that of Bone and M'Court. So far as one can gather, the collaborated research work of Bone and Wheeler was the starting point of the process. Mr. M'Court, as Works Manager, was largely responsible for the real development in converting research results and anticipations into a patentable invention, such developments depending largely on a working knowledge of refractory materials—a branch of technology in which Mr. M'Court had had special facilities and many opportunities.

It is only fair to mention here the patents that were taken out by P. M. Justice in 1903 for the Missouri Locovolo Company. His steam generator is filled with granular refractory material, and from his drawings it is safe to say that he obtained effects analogous to those obtained by modern surface combustion. The drawings are a good illustration of how nearly various workers may independently approach each other. He claims for restriction of the zone of combustion, but adds no theoretical explanation.

So much for a rapid and confessedly incomplete historical review of the subject. It is not vital to the actual argument which the writer wishes to develop; but it is interesting as drawing attention to the antiquity of the subject and its obviously widely known nature. In this country we have been largely dependent for our knowledge of the subject on the popular scientific discourses of Professor Bone, which discourses, though mentioning such old workers as Davy and Fletcher, are naturally but little concerned with the contemporary work of Lucke and Schnabel, Jüptner, &c. The Technical Press and patent files will, however, sufficiently redress the balance for inquiring readers.

Industrial Applications.

With the actual industrial uses to which intensified combustion has been put the writer has here but little concern, beyond noting that such industrial applications include a boiler, a crucible and muffle furnace, a radiating diaphragm, and metal-melting devices. The number and variety of applications are, of course, just so many as suitability, ingenuity, and necessity may devise. Such industrial results are better left until we have, in the natural course of events, the actual experiences and unbiassed results of independent practical people who have used the system and met with either success or failure. Such independent results, of either success or failure, would be of great service to the public and to the exploiters of the process. Perhaps the writer might venture to ask for such results; for it would be a great pity if the system were either neglected for lack of such data or adopted under a misconception. The industrial side interests the writer only because the improvement of gaseous firing will always be of vital importance, and consequent interest, to the general public.

Et Augebitur Scientia.

It is in the actual phenomenon itself, the title, "flameless incandescent surface combustion," and the explanations put forward, that the interest seems to centre. It would be futile indeed to deny in any way the potentialities of the actual patented process. On the contrary, the writer welcomes it as a decided advance in the science of gaseous firing—an advance which, in the hands of skilled practical chemical engineers, may yet prove to be of service to the users of gaseous and oil fuels.

In just such a way has the application of science to combustion enabled high-pressure gas [a close analogue to the subject of this article] to make enormous strides, notably in Birmingham; and the Birmingham pioneers would be the first to acknowledge the great debt they owe to contact with the acknowledged English leaders in combustion. It is to such leaders that one naturally looks for guidance along new paths in the applications of modern gaseous fuels; and this particular case is a splendid argument for those who favour the idea that specific industries should ungrudgingly foster scientific work as it bears upon their own particular industry.

The applications of intensified combustion as exemplified in the cases of flameless incandescent surface combustion and its near relative high-pressure gas, are intimately and inseparably connected with the Livesey Chair at Leeds University; and there is abundant reason to expect that, in future generations, provided the same care as has hitherto been displayed in the choice of intellect and personality is adhered to in filling the chair, the gas industry will reap continuous and increasing benefit therefrom. But, to get down to actualities, the position of affairs in flameless incandescent surface combustion is that this process has been placed on the market. It is a technical reality, and has been described as a catalytic process. The great claims made for the process—they are very great—have been more or less directly attributed to its catalytic nature; and there is no doubt that a good deal of the public interest in the process was directly attributable to the so-called catalytic phenomena. It is important, therefore, to actually examine these claims apart from the great authority attaching to the academic position and standing of the patentees; and the Technical Press seems a suitable medium for examining a technical process. A more detailed scientific examination can be left to the pages of a purely scientific journal.

Catalysis.

Now, in his lectures, Professor Bone gives a general review of catalytic combustion as examined at low temperatures. Then he unhesitatingly bridges the gap by saying that these results are applicable to flameless incandescent surface combustion. The high temperature phenomena are distinctly classed as catalytic. Catalytic phenomena have so far been understood to mean processes in which, by some as yet unexplained mechanism, a chemical change is induced in a chemical system *which otherwise would not tend to change, or at least whose rate of change would otherwise be considerably smaller.* Such stimulation or speeding-up is usually regarded as being due to the influence of a foreign body called the "catalyst." In flameless incandescent surface combustion the catalyst or foreign body is usually a refractory body known as the "surface."

In dealing with low-temperature changes in gaseous systems we have the conditions to hand which render useful the aid of a catalyst or artificial stimulant; and when Professor Bone is describing the effects of a surface—porcelain, fire-clay, silver, gold, platinum, &c.—it is highly important to remember that he is dealing with gaseous mixtures so arranged that, at the temperatures he and his collaborators employed, *the natural tendency for combustion to take place was not great.* Obviously this is the case, or the use of a catalyst is neither necessary nor noticeable. Now such low-temperature results have been definitely established by experiment in this country and elsewhere. It is useless to dispute them, unless one can, on repeating the experiments, establish differences or new points.

It would be as well to note here that the writer does not criticize these low-temperature results. He may, and does, reserve judgment on the explanations advanced; but such results as have lately been published by H. Hartley, before the Royal Society, and which will probably be further elaborated before the Institution of Gas Engineers, are valuable in the extreme so far as it is recognized that they apply strictly, as yet, to the low temperatures at which they were obtained. The technical uses, however, to which these results are put become sufficiently legitimate objects of criticism when one is considering a technical process. Whether or not the process of flameless incandescent surface combustion is really catalytic, whether or not it does depend on the factors elucidated in low-temperature work, is a very important consideration indeed, and one which, before being advanced, should be backed by experimental proof of a rigid nature.

Experimental Proof Required.

The writer has not yet come across this experimental proof. The technical public have a right to it, undoubtedly, if it can be demonstrated. But instead of proving the matter, so far as his lectures show, Professor Bone "contends" (a very different matter) "that if hot solids possess the power of accelerating gaseous combustion at temperatures in the neighbourhood of the ignition point, the same power must also be manifested at higher temperatures, and especially so when the surface itself becomes incandescent. Indeed 'my belief' is that not only does the accelerating influence of the surface upon combustion rapidly increase with the temperature, but also that the differences between the powers of various surfaces (which at low temperatures are often considerable) diminish with ascending temperatures until at bright incandescence they practically disappear."

It will be apparent, from the above quotation, that when we come to the vital point and justification of incandescent flameless surface combustion, in place of experimental proof, we have "contention" and "belief." It is natural therefore here to insert a plea for proofs dealing with "incandescent phenomena" and, in the present default of such published proofs, to criticize and act on one's own judgment.

Incidentally, the latter portion of the quotation might easily be interpreted as showing that at incandescence, instead of all surfaces possessing the same accelerating power, *this accelerating power is overshadowed by some stronger effect, which, masking all catalytic effects, gives a constant great velocity of combustion.* In other words, Professor Bone's interpretation could, with little effort, be entirely inverted.

Is Catalysis Necessary?

Further, it is worthy of especial note that, in dealing with flameless incandescent surface combustion, one is dealing with a case of chemical change in a gaseous system which will, and must, go on, to at least a very large extent, independently of a catalytic agent, since, by definition, a catalyst is that which promotes an otherwise less noticeable chemical change; but when an explosive gaseous mixture is brought into contact with an incandescent solid (at 1400° C. to 1600° C.), it is important to pause and inquire whether one really needs a "catalyst" at all. Hitherto it has been safe to assume that when one blows an explosive mixture on to a solid (liquid or gas) at 1600° C., the natural chemical reactivity of the *explosive* mixture would be at once and noticeably apparent. So that, in order to maintain that the process of flameless incandescent surface combustion is "catalytic," one must be prepared to prove—

(1) That the major portion of the combustion is due to catalysis and to no other cause.
(2) That the natural "combustibility" of the *explosive* mixture is overcome and replaced by catalysis.
(3) That the normal method of molecular interchange is rendered impossible by the presence of the surface—*e.g.*, by dissociation effects produced by surface.

In case 3, contrary to Professor Bone's views, Frederick Siemens would be a supporter of surface combustion. When one remembers how difficult it would be to restrain combustion in an explosive mixture at 1600° C. (independent of surface), one can realize the difficulty which surface combustion adherents will have to face in devising a crucial experiment. The writer will acknowledge with unqualified cordiality any work which does this, although in his own mind it seems an easier matter to devise crucial experiments to prove the *absence* of catalysis *as the controlling factor.*

If one can do so without presumption, one would like to interject a word of warning here to would-be workers on the subject; and that is to beware of the fascinating influence of the word "catalysis." Catalysis—that is, induced chemical changes—does exist; of that there is not any doubt. But the word "catalysis" is nearly allied in appearance to "catalepsy;" and the writer would suggest (humorously and without offence) that the resemblance is more than superficial. "Catalysis" may conceivably exert the same benumbing influence on the chemical outlook as does the actual cataleptic state on the physical body.

Explanations Advanced.

It is time, now, to consider what explanations are advanced as accounting for the catalytic action of surfaces at incandescence. The theoretical descriptions of the phenomena will be found on analysis to contain the words "catalytic," "accelerating," "surface," and "flameless." Briefly put, the accelerating influence is said to be "surface." The action is described as "catalytic." The novelty of the phenomena is twofold—viz., "flamelessness" and "rapidity." The writer sees no reason or experimental proof against taking up the attitude that—

(1) The process is not catalytic (in the main).
(2) It is not unduly or phenomenally rapid.
(3) Flamelessness is less due to surface than to aëration.
(4) The rapidity is more like detonation than anything else.
(5) The surface is less of a "catalyzer" than a "detonator."

In detail we may take a few extracts from published accounts of "surface combustion." Thus:

Combustion Classified.

It is therefore necessary to distinguish between two possible conditions under which gaseous combustion may occur—namely: (1) *Homogeneously* . . . slowly and without flame . . . rapidly and with flame. (2) *Heterogeneously*, or only in layers immediately in contact with an *incandescent* surface—surface combustion—(italics partly by the writer).

"It is also necessary to remember that, *ceteris paribus*, the heterogeneous surface combustion is a faster process than the normal homogeneous combustion of ordinary flame."

Now this is a collection of scientific words which would satisfactorily convince a lay audience or an uncritical scientific audience. Examined critically, the generalizations seem to be defective, and the writer will now very briefly indicate why.

Classification Criticized.

(1) While homogeneous combustion is divided into *two* classes, without and with flame, the analogous classification of heterogeneous combustion without and with an *incandescent* surface is not given. The critical point as to whether *low temperature* heterogeneous or surface combustion is the same as *high temperature* incandescent surface combustion is ignored in quite a misleading manner. Provisionally, at any rate, the phenomena of low-temperature work should be separated (because they are proved) from the phenomena of high temperature solids (because they are "believed in" and not yet proved). It is rather "hustling" matters, surely, to assume that they are the same?

(2) The phrase *ceteris paribus*, meaning "other things being equal," is surely not admissible here. The essence of a distinction between slow homogeneous combustion and heterogeneous incandescent surface combustion is that *ceteris paribus* is not the case. How can one compare low temperature results with results at 1600° C. when the *normal* velocity of chemical change increases in proportion to the increase of temperature? So that anything assumed on a *ceteris paribus* basis is open to doubt, since the basic assumption is impossible of realization. *Quot homines tot sententiæ*, is more suitable, and equally good Latin.

(3) The "*heterogeneous*" combustion is definitely (by Professor Bone) limited to "layers immediately in contact with an incandescent surface." The experimental laboratory results have so far been obtained with solid surfaces which are not incandescent, as, for example, the results of Bone and Wheeler, Forshaw, Andrew, and Hartley. These results are *not included* in the above classification given by Professor Bone, since they certainly did not take place in contact with an incandescent surface.

Yet the low temperature results are those from which important deductions are made concerning high temperature flameless incandescent surface combustion. This argument—a leaping over of gaps—hardly seems sufficiently logical and comprehensive to convince one. Is the combination of hydrogen and oxygen in contact with a gold surface combustion? If not, what is it? If it is combustion, is it homogeneous or heterogeneous? There is no room for it as Professor Bone's classification is worded.

Still one more point anent this classification, and I will pass on to more interesting pastures. In comparing homogeneous combustion with heterogeneous combustion, the deduction is made that homogeneous combustion is slower than heterogeneous. This deduction is partly based on results obtained by heating to a low temperature a mixture of combustible gas with oxygen in a sealed bulb. These experimental results cannot be compared with circulation experiments. In bulb experiments the tendency is to set up equilibrium; and when equilibrium is set up, further alteration in the mixture does not occur—in other words, combustion ceases. But in circulation experiments the *products of combustion are removed* in some cases. Equilibrium can never be finally established in a system where products are removed until the original mixture disappears. In other words, combustion *can proceed to completion.*

It is thus not possible to argue on the rate of combustion as between one case where combustion is automatically stifled and

another case where it is not so stifled, but encouraged by the removal of undesirable influences.

Detonation.

The word heterogeneous is similar in meaning, as here employed, to the word discontinuous. The word discontinuous has been employed, with legitimate accuracy, to the phenomena of detonation, as investigated by Harold B. Dixon. Bone refers in his lectures to "detonation," but definitely says it has no "direct" bearing on the subject of "flameless incandescent surface combustion." "Detonation" is treated in a manner almost as summary as is poor old "flame combustion" in the following eloquent passage: "On the contrary . . . the stately minuet of ordinary flame combustion gives place to the wild intoxication of the Venusberg."

Now, in point of fact, the conception which regards surface combustion as a species of "detonation"—granted that it is "strangled" detonation—is very fruitful indeed, and improves on acquaintance. We shall make further acquaintance with it later on.

The element of poetic justice would also be represented, for it would be a fitting thing had Professor Bone succeeded in "taming" the detonation wave of his old teacher and guide, Harold B. Dixon, who for so long has regarded it with an affectionate but wary eye. It would be no mean matter to turn to man's service the death dealing properties of the "explosion wave"—that spectre of the coal mine, which even now is engaging the earnest attention of the Home Office Committee.

Rôle of Surface.

But no such evolutionary and conservative principle is enunciated. Having "emphasized the fact that the incandescent solid plays a specific *rôle* in this surface combustion, it is no mere idle 'looker on' at the surging crowd of reacting molecules which swarm around it. On the contrary . . . the stately minuet of ordinary flame combustion gives place to the wild intoxication of the Venusberg." Having emphasized this, the lecturer puts forward verbal explanations of the "wild intoxication," the most important of which are—

(1) The gas is absorbed by the surface; being thereby "activated" and made combustible.
(2) The incandescent surface emits electrons which promote combustion (Sir J. J. Thomson).

About these suggestions it will be noticed that—

(1) They are derived from such low temperature work as has lately been published by Hartley.
(2) They are opposed, one to the other, in that suggestion (1) depends upon the reacting gases, while suggestion (2) depends on gas, but not necessarily the gas of the combustible mixture. Any occluded gas would serve to start the electronic emission.
(3) Both postulate combustion in molecular layers.

[In Professor Bone's lecture there is nothing to reconcile this discrepancy; but in Hartley's paper on low-temperature work it is shown that (2) might conceivably depend on (1). This is merely a "view," however, and is not as yet definitely established.]

Examining these suggestions it is easy to see that suggestion (1), which requires the combustible (or other) gas to go in and out of the surface, is very much open to argument. In order to explain a very rapid phenomenon, it is postulating *an intermediate process*, which, rapid though it may be, must take time. It is too roundabout. But accept it for one second, and examine the consequences. Incandescent surface combustion can deal with coal gas. Among other things, 30 per cent. of coal gas, at least, is made up of hydrocarbons. From the isolation of aldehydes during hydrocarbon combustion, Professor Bone some years ago advanced the suggestion—and the suggestion gradually hardened into a theory—that hydrocarbons burn in stages; the process being conveniently known as hydroxylation. This suggestion seems to have followed along lines suggested by Professor H. E. Armstrong, and involved the formation during hydrocarbon combustion of successive oxidation products, such as aldehydes, alcohols, acids, carbon dioxide, and water.

In incandescent surface combustion does this hydroxylation occur? Does the product of each stage need "activation," and a visit to the interior of the surface? Is the rapid process of incandescent flameless surface combustion in the case of hydrocarbons such a succession of stages as activated aldehydes, activated alcohol, &c.; the products of each stage paying a visit to the interior? There seems need here for a definite choice between the "hydroxylation theory" and the absorption theory of surface combustion; they are combined with difficulty. Certainly the phenomena of surface combustion, above and below incandescence, are of absorbing interest; and it was not for nought that the mighty intellect of Faraday was troubled.

Suggestion (2), depending on electronic discharges, is worthy of attention as coming from Sir J. J. Thomson. Its use for surface combustion, however, need not be narrowed as it has been. If electrons are necessary for the initiation of combustion—and well they might be—is it of paramount necessity to assume that they come from the incandescent solid? It is well known that ordinary flames contain ions and emit electrons. May not our electronic discharges come from the reacting gases? They would be more available as being more highly dispersed.

Molecular Layer Combustion.

Consider for just a moment what it means to limit gaseous reaction to molecular layers in contact with the surface, as Professor Bone would have us do. It means to say that combustion in the undoubtedly "gross," and enormous spaces left in any packed tube or diaphragm cannot take place until the gases get within molecular reach of the surface. The "spaces" in a tightly-packed diaphragm, as compared with "molecular layers," are as the solar system to a pin point. Lord Kelvin calculated that "if a drop of water were magnified to the size of the earth, each molecule being proportionately enlarged, the grained appearance the mass would present would probably be finer than that of a heap of cricket balls, but coarser than a heap of small shot."

It is in layers of such magnitude that one is asked to believe that flameless incandescent surface combustion really takes place; the mass of gas passing through the relatively enormous "holes"—*i.e.*, gas spaces. What of that? Is it burning? Does an explosive mixture immersed in a solid matrix at 1400° to 1600° C. explode? *Or does it wait until the surface can attend to it?* Does no combustion occur within $\frac{1}{32}$ of an inch of the surface at 1400° to 1600° C.? [Even at the risk of repetition, the writer would point out that such arguments are not intended to apply to such low temperature phenomena as have been elucidated by his friend Mr. Harold Hartley, but only to incandescent phenomena, where the *inevitable* chemical reactivity of an explosive mixture comes into play. In low temperature conditions, the chemical reactivity is *normally small.*]

Surely we have some fallacies somewhere? In the writer's opinion, the fallacies have crept in from such reasons as the following:

(1) The subject needs more quantitative examination.
(2) Results obtained at low temperatures have been applied to explain phenomena occurring at high temperatures. This is justified with difficulty.
(3) The factor of aëration is unaccountably and illogically neglected.
(4) Causes other than surface action have received less than due attention.
(5) The natural "combustibility" of explosive mixtures, when brought into contact with a solid at 1600° C., is not allowed for. *It is quite possible that a critical point is reached where catalysis is replaced by detonation.*

Point (2) has been dealt with previously, as also point (4).

In the case of (3), it is profitable to consider the well-known effects of increased aëration on the size of flames.

Aëration and Flame.

Consider, briefly, the relative sizes of—

(1) A luminous coal-gas flame from a bunsen burner.
(2) An aërated bunsen flame.
(3) An over aërated "roaring" bunsen flame.
(4) A Méker flame.
(5) An oxycoal-gas flame.

Is it not correct to suggest that here we have flame reduced in size in proportion to its aëration? Can we not even say that aëration *tends to cause flame to disappear?* But why does not an oxycoal-gas flame disappear altogether, since it is almost fully aërated? The reason is that even an oxycoal-gas flame takes time to mix and to burn. The molecules must be "tuned-up" in order to actively burn. But let us impinge the oxycoal-gas mixture on to a solid at 1600° C. Would one expect flame? The answer is in the negative. Let us regard a luminous straggling flame *as a manifestation of insufficient aëration.* Let us regard the "straggling" appearance as being due to a "reaching out" for oxygen. On presenting a "well-aërated mixture to the incandescent surface at 1600° C. the necessity for stretching out is obviated; the temperature of 1600° C. supplies the "tuning up." In other words, the *necessity for a flame disappears*, on both counts. In such a manner is aëration the potent factor in producing flamelessness, and flamelessness can be explained without the intervention of catalysis. This conception of the action of a surface would render the combustion homogeneous over a definite area dependent on the velocity of flow of the mixed gases. The non-burning flow of gases need not be considered as part of the burning mixture.

Detonation Again.

In discussing point (5), on the natural tendency to burn of an explosive mixture at 1600° C., we come to a more detailed consideration of "detonation." In suggesting that a species of detonation (not quite the detonation wave) is what really occurs in the tube of a Bonecourt boiler, the attention of the reader is drawn to the following cardinal points:

(1) "Detonation" is an exceedingly rapid method of combustion.
(2) It is a propagation of chemical change in a gaseous medium which can progress without the intervention of a solid surface.
(3) It is propagated by adiabatic compression and the heat thereby generated.
(4) In the "detonation wave" the chemical change is propagated in a thin layer known as the "wave front."
(5) Before detonation can be set up and maintained, a source of heat is necessary, and this source of heat is either supplied by adiabatic compression or its equivalent.

In the application to incandescent surface combustion and the general theory of catalytic phenomena, item (2) is of paramount importance.

In regard to point (5), the writer would suggest that an incandescent solid at 1600° C. is a heat reservoir of such potency that it can, and does, *replace the adiabatic compression*. The setting up of a wave, which would blow a boiler to atoms, is prevented by the baffling due to the granular refractory material, and also by the rapid flow of the explosive mixture in a direction opposite to the potential direction of the explosion wave. Obviously, this is unfavourable to the setting-up of a definite explosion wave.

Summing up, we can isolate the following heads:

(1) The phenomena of a "platinum" combustion at low temperatures are not disputed, though their mechanism may be obscure.

(2) It is fallacious, however, to use them unreservedly in order to interpret "incandescent solid" phenomena.

(3) "Incandescent surface combustion" is probably not "catalytic" in its main features, but is more likely to be "strangled detonation." The surface is more accurately described as a "detonator" than as a "catalyzer" in the ordinary sense of the term.

(4) "Flamelessness," which is not disputed, is not to be regarded as unexpected, since one can expect to get just as much "flame" *and of the same character* as one gets in "detonation" phenomena (except the "after flame" of carbon monoxide). The causes of flamelessness are *aeration and rapidity of combustion.*

In conclusion, the purpose of this critical review of the interpretative side of surface combustion will be amply served if such criticism should lead to either the publication of crucial facts already worked out, or, on the other hand, it should serve to stimulate further work on the subject. Intensive gaseous combustion has come to stay; and the gas industry will some day owe to it a great and lasting debt.

CHEAPER CIRCULATING BOILERS OR HIGHER EFFICIENCIES.

JUST recently, Mr. Thomas Potterton raised with us the question as to whether it was altogether wise to press too far the production of cheaper gas-heated circulating boilers, if this meant the degrading of efficiencies, and therefore permanent losses to the consumers. In compliance with demand, he, like other makers, has made cheaper circulating boilers; but from his cheaper single boilers, as from those of other makers, he holds that it is impossible to get the same high efficiencies as with the better and rather more expensive makes. Money, he says, must be spent in the making to secure the highest efficiencies. To prove his point, he has had certain tests made, with his own cheaper circulating-boiler, and those of other makers, and the figures can be compared with those of the higher priced "Victor" boilers. The points of comparison are the B.Th.U. per cubic foot to the right-hand side of the tables.

CHEAPER AND LOWER EFFICIENCY BOILERS.

Test of No. 101 "Victor" Gas-Boiler, as in Use for General Household Purposes, Burning a Given Quantity of Gas and Drawing Hot Water, Taking the Registers of Hottest Available for Sink Purposes, and Larger Quantities for Baths. (*May* 18, 1914.)

Temperature of Water, 57° Fahr. ¾ inch Flow, ½ inch Return.
Flow carried into expansion pipe (Potterton's System).

	Flow.		Gas.
Gas lighted 10.0	57° Fahr.	..	—
5	78° ,,	..	3½ Cubic Feet.
10	120° ,,	..	6½ ,,
15	129° ,,	..	10 ,,
20	131° ,,	..	14 ,,
25	132° ,,	..	17½ ,,
30	133° ,,	..	20½ ,,
35	135° ,,	..	24 ,,
36½	136° ,,	..	25 ,,

25 Cubic Feet of Gas Consumed.
Hottest Water 128° Fahr.

	Tap.		Bulk.
5 gallons	125° Fahr.	..	115° Fahr.
10 ,,	118° ,,	..	117° ,,
15 ,,	75° ,,	..	105° ,,
20 ,,	70° ,,	..	98° ,, = **328** B.Th.U. per cubic foot of gas used.

	Flow.		Gas.
Continuing 10.50	130° Fahr.	..	35 Cubic Feet.
55	132° ,,	..	38¼ ,,
11.0	134° ,,	..	41½ ,,
5	135° ,,	..	45 ,,
10	135° ,,	..	48½ ,,
12½	135° ,,	..	50 ,,

Second **25** Cubic Feet of Gas Consumed.
Hottest Water, 129° Fahr.

	Tap.		Bulk.
5 gallons	127° Fahr.	..	117° Fahr.
10 ,,	119° ,,	..	118° ,,
15 ,,	77° ,,	..	110° ,,
20 ,,	72° ,,	..	102° ,, = **360** B.Th.U. per cubic foot of gas used.

Similar Tests with Another Make of Cheaper Class Boiler.
(*May* 18, 1914.)

Temperature of Water, 61° Fahr.

	Flow.		Gas.
Gas lighted 2.0	61° Fahr.	..	—
5	84° ,,	..	3½ Cubic Feet.
10	114° ,,	..	6½ ,,
15	117° ,,	..	9¾ ,,
20	119° ,,	..	13 ,,
25	120° ,,	..	16½ ,,
30	121° ,,	..	20 ,,
35	122° ,,	..	23½ ,,
37	123° ,,	..	25 ,,

25 Cubic Feet of Gas Consumed.
Hottest Water, 120° Fahr.

	Tap.		Bulk.
5 gallons	119° Fahr.	..	110° Fahr.
10 ,,	112° ,,	..	111° ,,
15 ,,	79° ,,	..	102° ,,
20 gallons	75° Fahr.	..	97° ,, = **288** B.Th.U. per cubic foot of gas used.

	Flow.		Gas.
Continuing 2.45	122° Fahr.	..	31 Cubic Feet.
50	122° ,,	..	34½ ,,
55	122° ,,	..	38 ,,
3.0	124° ,,	..	41½ ,,
5	125° ,,	..	45 ,,
10	125° ,,	..	48½ ,,
13	125° ,,	..	50 ,,

Second **25** Cubic Feet Gas Consumed.
Hottest Water, 123° Fahr.

	Tap.		Bulk.
5 gallons	123° Fahr.	..	115° Fahr.
10 ,,	116° ,,	..	115° ,,
15 ,,	78° ,,	..	111° ,,
20 ,,	75° ,,	..	102° ,, = **328** B.Th.U. of gas used.

Other tests of other makes of boilers coming in the same category show results, after consuming 25 cubic feet of gas, very similar to the 288 B.Th.U. mentioned above.

HIGHER PRICED AND HIGHER EFFICIENCY BOILERS.

Test of No. 21 "Victor" Self-Contained Apparatus.

Temperature of Water, 55° Fahr. 25 Cubic Feet Gas Consumed.
Hottest Water, 150° Fahr. (at commencement to draw).
After 20 gallons of water drawn. At tap, 87°; in bulk, 108° = **424** B.Th.U per cubic foot of gas used.

Test of No. 18 "Victor" Boiler.

Temperature of Water, 54° Fahr. 25 Cubic Feet Gas Consumed.
Hottest Water, 132° Fahr. (at commencement to draw.)
After 20 gallons of water drawn. At tap, 70°; in bulk, 103° = **392** B.Th.U. per cubic foot of gas used.

Now if the B.Th.U. transferred to the water per cubic foot of gas are compared at the end of the use of 25 cubic feet of gas, the point that Mr. Potterton makes will be clearly seen. Cheapness does not mean the highest efficiencies, because the highest efficiency boilers cannot be made and sold for the price of the lower efficiency ones. With regard to the B.Th.U. results shown by the last two boilers, if the tests had been continued, by a second 25 cubic feet of gas being consumed in each case, there would have been a rise in the B.Th.U. per cubic foot transferred to the water, just in the same way as is shown by the tests, with the cheaper class boilers—only more so.

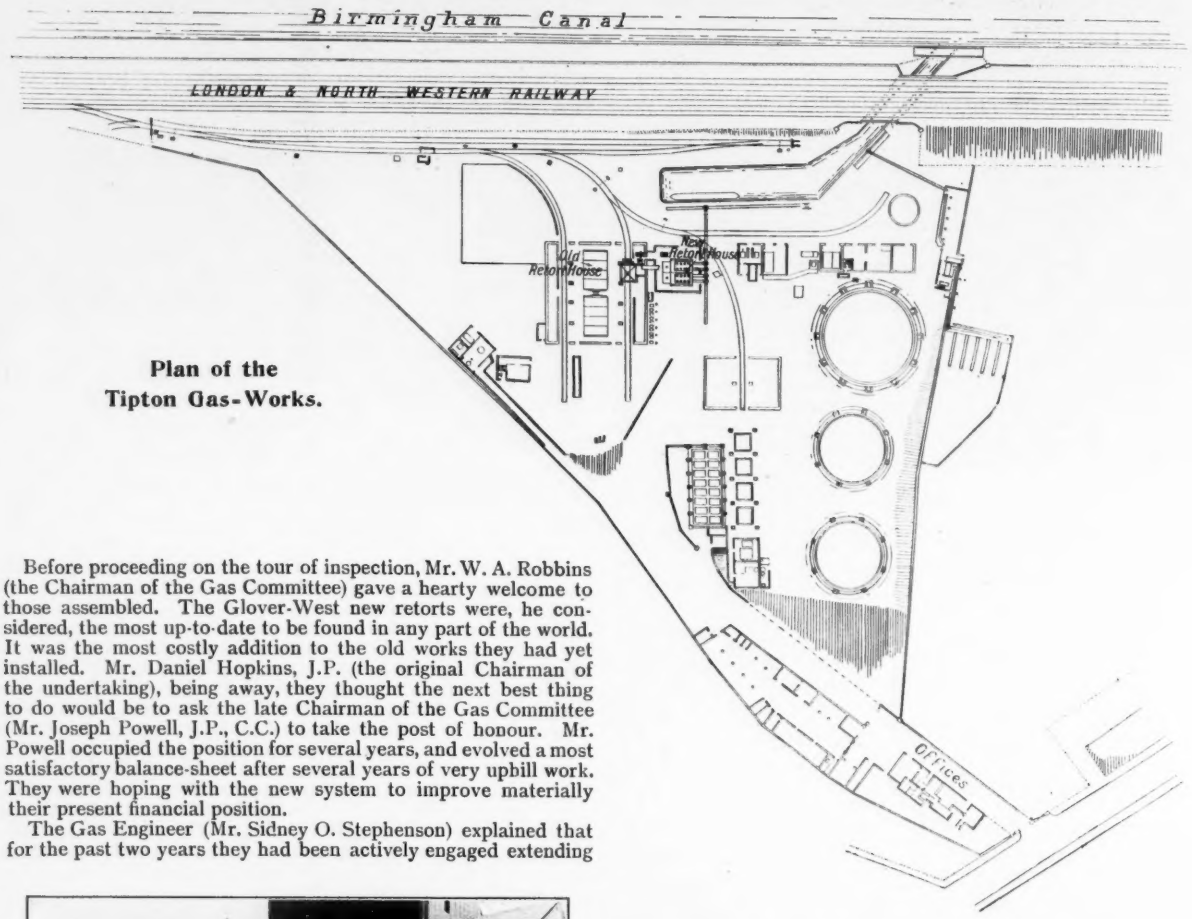
Properties of Peat Tar.

In gasifying peat with the double object of utilizing this fuel as a source of heat and extracting its nitrogen, a tar is produced of which the precise nature was not exactly known. Messrs. E. & F. Bernstein have made a study of two samples, and from one of them obtained products boiling between 150° and 330° C. Applying to the products of the distillation of 5 kilos. of tar the known methods of separation, to extract the phenol and alkaloids, they obtained 15 per cent. of phenol, 35 per cent. of indifferent oils, 47 per cent. of pitch. Applying directly to the tar the method of extraction with alcohol ether, 24·1 per cent. of paraffin was obtained; its melting point being 65° C. It therefore appears that peat tar can be profitably worked for the extraction of paraffin and vaseline oils. It is considered to be not improbable that the superior phenols which it yields in abundance will find useful employment either for the preservation of wood or for the derivatives they can furnish reacting with formaldehyde or in the form of nitro-derivatives.

GLOVER-WEST VERTICAL RETORTS AT TIPTON.

Formal Opening of the Installation and Other New Works.

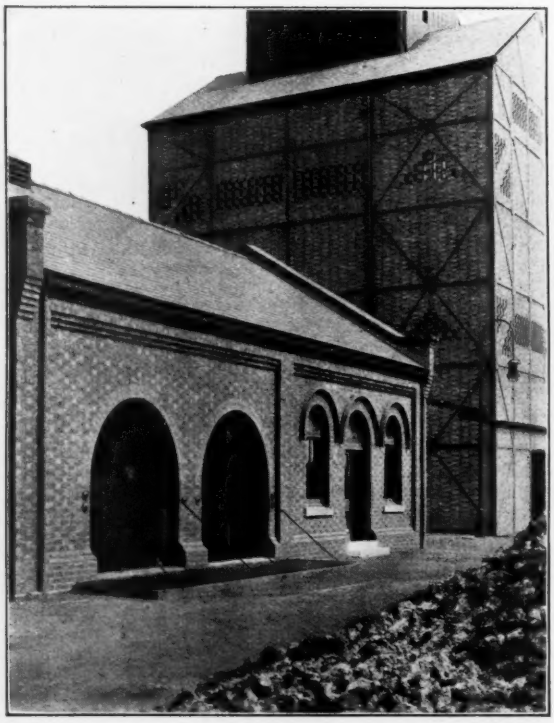
THERE was an interesting ceremony at the Tipton District Council Gas-Works last Wednesday afternoon, when a new vertical retort-house which has been erected on the Glover-West system, at a total cost of about £12,000, was opened by Mr. J. Powell, the late Chairman of the Gas Committee. The gathering was a large and representative one. The guests were received by the Chairman of the Gas Committee (Mr. W. A. Robbins) and the Engineer and Manager (Mr. Sidney O. Stephenson). The particulars of the installations given below have been taken from an illustrated pamphlet prepared for the occasion.



Plan of the Tipton Gas-Works.

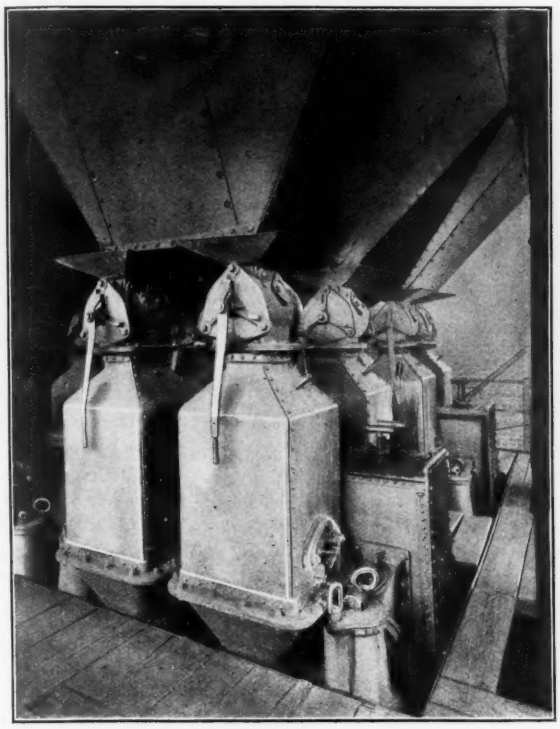
Before proceeding on the tour of inspection, Mr. W. A. Robbins (the Chairman of the Gas Committee) gave a hearty welcome to those assembled. The Glover-West new retorts were, he considered, the most up-to-date to be found in any part of the world. It was the most costly addition to the old works they had yet installed. Mr. Daniel Hopkins, J.P. (the original Chairman of the undertaking), being away, they thought the next best thing to do would be to ask the late Chairman of the Gas Committee (Mr. Joseph Powell, J.P., C.C.) to take the post of honour. Mr. Powell occupied the position for several years, and evolved a most satisfactory balance-sheet after several years of very uphill work. They were hoping with the new system to improve materially their present financial position.

The Gas Engineer (Mr. Sidney O. Stephenson) explained that for the past two years they had been actively engaged extending and modernizing the gas-works to meet the increasing demands for gas, and also to manufacture as economically as possible. These extensions were now practically completed; for although several small things yet remained to be done, they were now in a position to meet all demands likely to be made upon them for some time to come. They were supplying a good quality gas, and were manufacturing upon a very economical scale. Though the population of Tipton had remained practically stationary, and the town was purely industrial (there being neither big houses nor big shops), the consumption of gas had steadily grown from 75 million cubic feet per annum to 150 millions, and was still going upwards —a position which was never contemplated when the works were built. It had been obvious, therefore, for some time that extensions would have to be undertaken. But they had been anxious to lay out their money to the best advantage; and the new vertical retorts were consequently not started upon any too soon. The last two or three winters had been full of anxiety for them in Tipton. However, these troubles were fortunately now past. The vertical retort system with continuous working came along at the right time for them; and they entertained no doubt, after full inquiry, that it was the best and most economical thing for them to adopt. They considered they had now got as economical and up-to-date a works for its size as could be found. He had great pleasure in calling upon Mr. Powell to perform the ceremony of opening the plant by moving a lever which would result in tipping a 10-ton waggon of coal.

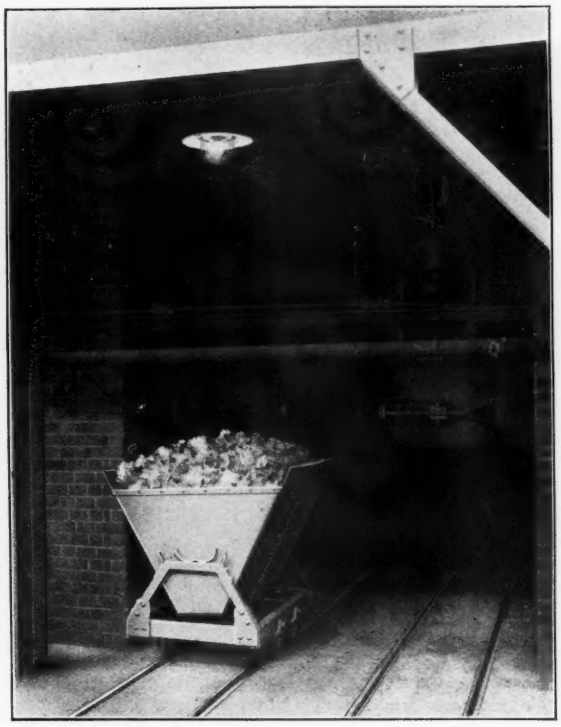


The New Engine and Boiler House and the Glover-West Vertical Retort-House.

Mr. POWELL then performed the ceremony, and, after thanking the Gas Committee for the invitation, said he felt in starting the machinery he was doing something that would stand out in the history of Tipton and of its gas-works as a progressive and prosperous concern. He believed the Tipton gas undertaking was now well on its feet, after many years of struggling. Since he first became a member of the Committee, they had had three installations. At one period they had direct firing; and then came the generator system. Now they had come to what he considered was the ideal. He believed the Glover-West retorts would stand the test of com-



Top of the Vertical Retorts, Showing the Coal-Bunkers and Feeding-Hoppers.



The Coal-Containing Chambers at the Bottom of the Glover-West Vertical Retorts.

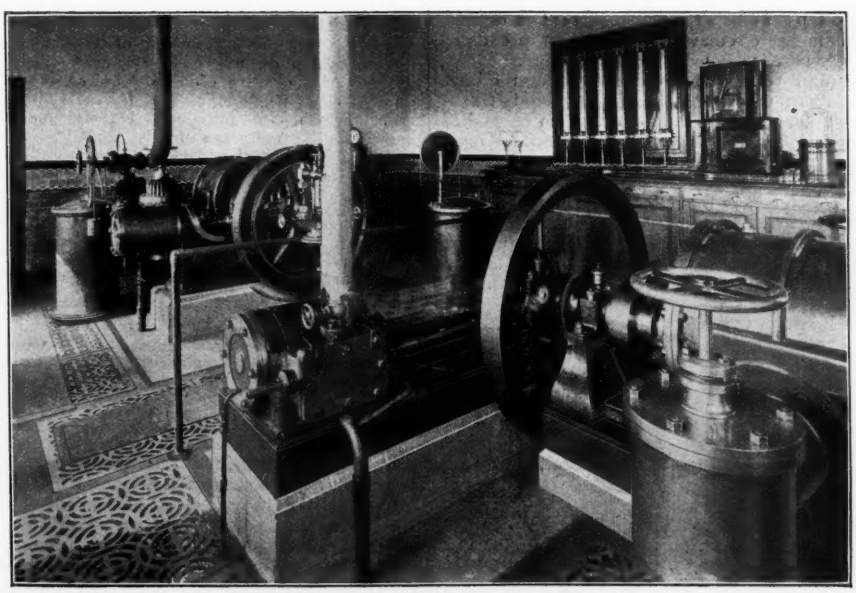
petition, and hold their own for some time to come. As one of the deputation who went to St. Helens and Manchester to see the vertical retorts there, he was more confirmed than ever in this opinion. There were, to his mind, many points to recommend vertical retorts. For one thing, they got rid of the waste from the mouthpieces, which was always a bugbear to him while he was Chairman of the Committee. He was always asking the Gas Manager how they could stop such a terrible waste. Then there was the matter of the charging and discharging. They all knew what this meant when the work was done by hand. Much of the best gas under the system was blown off into the air, and poisoned the men. This was remedied in connection with the vertical system. They had now, he believed, at Tipton a perfect system, which augured well for the success of the town; and they were inaugurating a plant which he felt would be a godsend to them It was going to be a financial success and a benefit all round.

TIPTON GAS SUPPLY.

Gas was first supplied in Tipton about the year 1845 by the Birmingham and Staffordshire Gaslight Company, from their works at Swan Village. This undertaking was acquired by the Birmingham Corporation in 1875; and in 1876 the Tipton Local Board of Health sought, and obtained, powers to purchase the rights of supply, so far as the parish of Tipton was concerned—the purchase price being £34,744. This figure did not include works, which had to be built at a cost of £40,000. They are conveniently situated almost in the centre of the parish, and contain railway sidings from the London and North-Western Railway and a canal basin. They were designed by the late Mr. Thomas Proud (Messrs. Kirkham and Hersey, of Westminster, being appointed Consulting Engineers), and were opened on July 1, 1882; Mr. Vincent Hughes (now of Smethwick) being the first Manager. The make of gas the first year was 75 million cubic feet.

In 1890 the storage capacity was found to be insufficient; and a new holder of 370,000 cubic feet capacity was erected to the designs of Mr. Hughes, bringing the full storage capacity up to 660,000 cubic feet. In 1900 the make of gas for the year was 99 million cubic feet, the number of consumers being 1700 ordinary and 538 prepayment; while, for the year ended March 31 last, the make had reached 149 million cubic feet.

The population of Tipton in 1911 was 31,756. There are 7600 houses; and the number of gas consumers at the present time is 1612 ordinary and 3500 prepayment. The sales of gas and its various uses are well pushed; and there are 1500 gas-cookers, 230 fires, 3000 boiling burners, and 54 gas-engines, besides water-heaters and other gas appliances in use. Free maintenance has been adopted; and burners, stoves, &c., are adjusted and attended to free of charge, thus ensuring their constant use, as well as



INTERIOR OF THE NEW ENGINE-HOUSE.

satisfaction to the consumer, and thereby maintaining the consumption of gas. In 1902 new purifiers were erected, and a Dellwik blue water-gas plant installed; the latter proving a valuable auxiliary to the coal-gas plant.

The ever-increasing consumption rendered a further extension of the manufacturing plant inevitable; the maintenance of the supply in mid-winter for the past three years having given considerable anxiety. Last winter the supply was only maintained with the greatest difficulty. In fact, a week's fog would have been impossible to cope with; but very fortunately this eventuality did not occur. Acting on the advice of the Engineer (Mr. Sidney O. Stephenson), the Gas Committee decided upon extensions, involving a new retort-house, with vertical retorts of a capacity of half-a-million cubic feet per diem, a new engine and boiler house, new exhauster, Lancashire boiler, 20 ft. by 7 ft., to work at 120 lbs. pressure, a rotary scrubber, &c., at a total cost of £12,000. The question of horizontal retorts with stoking machinery was considered, but for economy in working would not bear comparison with vertical retorts.

The maximum day's output of gas is 700,000 cubic feet; and the water-gas plant and the old horizontal retorts will be held in reserve and utilized in the winter time to make up the necessary production, until such time as further extensions of the vertical retorts may be undertaken.

THE GLOVER-WEST VERTICALS.

The vertical retort house has been erected alongside the old retort-house; the power-house containing the engines driving the coal-elevator, extracting gear, &c., as well as the breaker and elevator pit and the coal-hopper, being built inside the old house. The coal, which is brought by the London and North-Western Railway into the gas-works sidings, is weighed into the works. It is then run along the siding into the old retort-house to the hopper. Waggons, which are fitted with end doors, are there raised on end by means of a hydraulic ram, and the coal shot into the hopper. It is then raised by the elevator to the hoppers at the top of the vertical retort house; big coal being previously passed through the breaker to reduce it to proper size. The overhead hoppers are made to contain rather more than a 24-hours' supply.

The new retort-house is constructed of steel framing, with brick filling, and contains two settings of eight retorts each, which, however, are arranged so that they can be worked in fours. The retorts are 25 feet long, set vertically, are built in sections, and taper from top to bottom. At the bottom of the retort is fitted the coke-extractor, which is constructed on the principle of the archimedian screw.

The coal, as before mentioned, is supplied to the coal feeding hopper above the retort, and slowly and continuously falls by gravitation to the retort, and through it to the coke-receiving chamber. The coal, on passing through the heated retort, becomes completely carbonized, and the residual coke is then extracted by the slowly-revolving coke-extractor. The speed of revolution of the extractor regulates the speed at which the coal passes through the retort. The driving gear of the coke-extractor is fitted with a device for regulating this speed. The coke discharged by the extractor is temporarily received and stored in the coke-receiving chamber, and is periodically discharged through a gas-tight outlet into tipping-waggons running on light rails.

The method of heating the retorts and utilizing the waste heat in this system is unique. The combustion chambers surrounding the retorts are super-imposed. Each chamber is separately heated, and has no connection with the chambers either above or below it. The products of combustion, after circulating round the retorts, make their exit to a vertical duct common to all the exits from the combustion chambers; and after passing through this duct they enter the chambers surrounding the top ends of the retorts. Through these top chambers the partially spent gases from all the combustion chambers circulate and heat the top ends of the retorts. The waste gases pass away to the chimney.

The secondary air supply enters and circulates round the base of the retorts, and in doing so extracts the heat, which is transmitted from the coke through the walls of the bottom section of the retorts. The utilization of the heat recovered from the coke results in very considerable economy in fuel consumption, and enables the coke to be discharged almost cold. By this process, the period of carbonization can be regulated according to the coal being used; so that the whole of the gas will be extracted from it without over-baking—thus getting the best results from the coal with a low fuel account, and a constant quality of gas. The flue chambers being separate, the heat can be regulated to each section of the retorts.

The coal gradually becomes carbonized in its passage through the retort; and the gas is taken off at the top of the retort, and passes away through a steel main to the condensers. A retort-house governor is fitted to regulate the pull on the retorts. There is no waste of gas from charging, no waste heat from the coke, no smoke and steam, and the house is cool, and working conditions comfortable. A lift is provided to take up the coke for feeding the furnaces; and it also goes to the top of the settings. Gas-engines are used to drive the extracting gear and the coal elevator and breaker.

Three works' foremen are employed, who, together with the three engine and boiler men, work on eight-hour shifts. The foremen look after the working at the top of the retorts; and the engine drivers see to the working of the gas-engine and pumps, and to the oiling and greasing of the machinery. The only other labour employed on the carbonizing is three men to remove the coke, feed the furnaces, clinker, and do anything else that may be necessary. So far the plant was realizing all expectations.

OTHER NEW WORKS.

The engine and boiler house do not call for special mention. Trenches are arranged in the floor of the engine-room for the mains, so that they are accessible. A new steam engine and exhauster, to pass 40,000 cubic feet per hour, has been installed by Messrs. R. & J. Dempster, who also supplied the rotary scrubber. A well-fitted and convenient foreman's office and a bath-room are also included in the same block of buildings. A Lancashire boiler, to work at 120 lbs. pressure, was installed, with the object of distributing the steam about the works at high pressure and reducing down where necessary. Among other items of interest on the works are a tar macadam plant (in which the whole of the tar macadam required for the roads in Tipton is made); and a steam-winch for hauling the coal-waggons. There is also a well-equipped laboratory; and the whole of the street-lamps are lighted and extinguished automatically by pressure-wave operated from the works.

The Luncheon.

Subsequently, on the invitation of the Chairman of the Gas Committee, and Messrs. West's Gas Improvement Company, the guests were entertained at luncheon at the Royal Oak Hotel, Dudley Port. Mr. ROBBINS presided. After the Loyal Toast had been honoured,

Mr. A. W. MACHONOCHIE (the prospective Unionist candidate for Wednesbury) submitted the toast of "The Town and Trade of Tipton." He said it seemed to him the Council had done the right thing in taking the bold step they had in introducing a new and entirely revolutionary system of gas production and works management. He urged that business was the basis of all social improvement, and by a successful municipal enterprise such as a gas undertaking the whole community was benefited.

Mr. T. E. SALTER (the Chairman of the Council) replied, and said the Council had done all they could to encourage the establishment of new industries; and it was gratifying to feel that their efforts were meeting with success.

Mr. CALLEAR also responded, and congratulated the Chairman of the Gas Committee upon the enterprise they had shown.

Alderman C. W. PINKNEY (the Chairman of the Smethwick Gas Committee) submitted "The Tipton Gas Undertaking." He congratulated the Committee upon the excellent sporting spirit they had displayed in their new departure and in the extension of their gas-works. Tipton, he said, now occupied a very important position in the gas industry. They were expected, with a high and increasing price of raw material, with a falling price for residuals, and with a demand for a uniform make of gas in heat and illuminating power, to sell it at a lower rate. All other trades and professions were expected to pass the rise on, and let the last purchaser or consumer pay. In municipal trading, they had to put up with the opposite view. To accomplish this, he believed at Tipton they had made the wisest choice they possibly could in adopting the vertical retort system. From it they would get a larger amount of gas per ton, and an increase in the residuals. If they were wise, they would not allow their purifying plant to be starved. This plant must be kept up; and the expenditure they made in this direction would, he believed, come back to them in handsome returns. They had been wisely advised by their excellent Engineer, Mr. Stephenson, in their selection; for the Glover-West system was not an experiment. It was a success. If he were in the hands of the same firm, he should have just the same confidence; for anything they touched must be finished well. The day was fast coming when there would be a demand for uniformity, and for a constant candle power in gas. It was up to them to supply gas in a uniform condition every hour of the day and night. If they did not, they would lose public confidence both in lighting and heating. He urged the Committee to loyally support their Chairman. If they had contention and discord, they would find the whole thing go to pieces. He wished them all prosperity.

Mr. ROBBINS, in reply, said he felt highly delighted to know that he had the co-operation and support of his Committee and the Council at large in putting down what he considered one of the most up-to-date plants in the country. They did not adopt the Glover-West system without every inquiry; and he believed they had a method of gas making which would prove to be both efficient and economical. They had passed through times of great anxiety; but the Gas Engineer had done splendidly, and had shown care and ability in controlling the affairs of the undertaking. The utmost credit was due to him.

The toast of "The Visitors" was submitted by Mr. A. SHEPHARD, and responded to by Mr. VINCENT HUGHES.

Mr. W. DOUGHTY proposed "The Engineer and Contractors," Messrs. STEPHENSON and FRED. J. WEST responding.

Absorption of Gases by Coal.—Dealing with this subject in the "Comptes Rendus" [CLVIII., 573], M. Leprince-Ringuet showed that such gases as fire-damp, carbon dioxide, air, oxygen, and methane, at pressures ranging from 0·25 to 80 atmospheres, were absorbed by coal to a much less extent than by charcoal; but in both cases the absorption was of the same general character. A state of equilibrium existed for each temperature and pressure, and the absorption markedly decreased as the temperature rose. The increased absorption with greater pressure was rapid at first, but gradually tended to a limit. Equilibrium was reached very slowly, and, in the case of carbon dioxide especially, evolution of the absorbed gas, however slowly effected, was spasmodic. Results of the same order of magnitude were obtained with coals of widely different composition and size of grain. They did not afford any explanation of the large evolution of fire-damp observed in very gassy mines.

MIDLAND JUNIOR GAS ASSOCIATION.

Visit to Stourbridge.

As a wind-up to the session, the Midland Junior Gas Association had arranged, by permission of the Gas Committee of the Urban District Council, to pay a visit to the Stourbridge Gas-Works. It was, therefore, with this object in view that some forty members proceeded to the town on Saturday afternoon.

They were fortunate—and so was Stourbridge; for never could it have been seen to greater advantage. Under a cloudless sky, and bathed in brilliant June sunshine, the town drew many complimentary remarks from the visitors, as they walked from the railway station up the main-street to the gas-works. Here the party, who were led by the President of the Association (Mr. W. H. Johns, Engineer of the West Bromwich Gas-Works), were received by the Engineer and Manager of the works (Mr. Charles H. Webb, M.Sc.), at whose hands they received the warmest of welcomes. The Stourbridge Gas Committee were represented by the Chairman (Mr. S. Fiddian), who showed his interest in the function by remaining until the close of the proceedings. There were also present Mr. C. Dakin, of Cradley Heath, and Mr. A. E. Layton, of Redditch. In the tour of inspection, the first party were conducted by Mr. Webb; while the others were in charge of Mr. Harold Jones, the Works Superintendent (who is a member of the Committee of the Midland Junior Association), Mr. N. L. Darby and Mr. S. Williams, Assistant Superintendents (who are also members of the Association), and Mr. H. Thomas, a pupil. Though the works are compact, there was more than enough to see in the time at disposal; and Mr. Webb can rest assured that his visitors did not have a dull moment.

Like many other prosperous gas undertakings, the present excellent works at Stourbridge have grown from small beginnings. They were established in 1835 by a company of six shareholders; and twenty years later the concern was incorporated by the Stourbridge Gas Act of 1855. The Urban District Council acquired the undertaking at the end of 1892; the cost being about £100,000. As a matter of fact, the works are situated immediately over the boundary of the Council's area in Amblecote Parish, Staffordshire; and the district supplied comprises Stourbridge, Amblecote, Lye, and a number of other places, having a total area of about 15,308 acres, and a population of nearly 40,000. The output of gas is high in proportion to the population; the area having, in addition to residential parts, large manufacturing districts with a working-class population. A large percentage of the gas is supplied for power and other trade uses; and there is also a heavy consumption by prepayment meters, gas-fires, and cookers. Remarkable progress has been made during the period that the works have been in the possession of the Council. The make of gas in 1892 (the last year under the Company) was 96 million cubic feet; whereas for the financial year 1913-14 it was 249 million feet. In the same time the mileage of mains has increased from 37 to 61; and the number of consumers from 1340 to 2263 ordinary and 5783 prepayment. From these figures, it will be seen that the proportion of prepayment consumers to those using ordinary meters is a striking feature of the business carried on by the undertaking. For the first-named year the gross profit was £4787; and for the past twelve months it was £11,354. In 1892 the price of gas was 2s. 8d. per 1000 cubic feet; while now the charges range from 2s. 8d. to 1s. 6d. per 1000 feet, according to the consumption and the purpose for which the gas is used. The number of cookers in use at the end of March last was 3308.

The first portion of the works to be inspected was the house in which current is generated for driving the retort-house stoking machinery. The plant for this purpose consists of two 50-B.H.P. gas-engines, coupled to 30 K.W. generators. Connected with the plant are both gas and electricity meters, so that it is easy to satisfy anyone as to the cost at which the current is generated. From this house, the members naturally passed to the machinery for the operation of which the electricity is required. The retort-house contains eight beds of eight retorts (21 ft. by 22 in. by 16 in.); and the members were fortunate in seeing one bed in course of renewal. The furnaces are of the Klönne regenerative type; and some of them have been in for twenty-four years, though, of course, the settings have been periodically renewed from the combustion chambers upwards. The whole of the works are built on a rock foundation. Hitherto the coke for charging has been dropped on the floor of the house and then fed into the furnaces; but Mr. Webb is now going to try something different. On the charging opening of the furnace is being fitted a short piece of retort, of the same section as the retorts above; the idea being that what comes out of a certain section of retort should be able to go straight through the same section into the furnace—being guided, of course, by a movable shoot.

Being desirous of adopting a more up-to-date system of retort-house working than hand charging with horizontal retorts, Mr. Webb evolved a scheme which he reckoned would give him what he wanted with a minimum expenditure, as the horizontal plant was far from being worn out. As a matter of fact, his outlay has been £4500, of which he spent £1000 on engines, dynamos, and switchboard, the same amount on stoking machinery, a third sum of £1000 on a telpher installation, and the remainder on coal-elevators and sundries. The newly-installed stoking machine is of the Guest-Gibbons type, with which the actions of charging and discharging are performed in separate movements; and this machine, Mr. Webb stated, is proving quite satisfactory. As much as 14 cwt. has been put in the retorts; but the regular charges are 12½ cwt., the time of carbonization being twelve hours. Dry mains are used; a level gauge being worked to. There are two eight-hour shifts—from nine to five day and night—no charging taking place during the intervening hours. The top retorts are charged at 9.30, the middle tier at 12 o'clock, and the bottom retorts at 3 o'clock; the same times being kept at each shift. The make of gas is about 12,000 cubic feet per ton, with a mixture of various coals. There are five beds at present in work; and whereas it used to require twenty-one men to perform the arduous labour of hand charging and two jumpers, there are now nine men and no jumpers; and they say that the physical exertion demanded of them is only one-third of what it used to be. Mr. Webb adopts a simple expedient for obviating labour troubles. He goes through his wages-book at a regular date each year, and gives such rises as he thinks should be given, without waiting for the men to ask for them.

The coke, on being pushed from the through retorts falls into a skip; two retorts being emptied in this way, so as to fill the skip, before the operation of charging is proceeded with. As the coke drops into the skip it is partly quenched by water-spray; and then the skip is taken by the telpher out of the retort-house, immersed in a tank of water, and the coke afterwards deposited on the stack in the yard. While the telpher is absent on this mission, the charging of the two retorts which had been emptied is accomplished. More than half of the coke is removed by carts from the yard for use in the numerous industrial works which are situated in the immediate neighbourhood; but one can foresee possible extensions of the coke-handling plant in the direction of affording facilities for grading and loading both into carts and into railway waggons on the low-level railway siding. The coke in store on Saturday was noticed to be of very good size.

Coal enters the works by a high-level railway siding, connected with the Great Western Railway, from which the waggons pass right into the retort-house. There are breakers and elevators, of 15 tons per hour capacity each, on both sides of the house, which feed into a hopper at the top of the retort-house holding 30 tons. From this the coal is taken into the small hopper on the charging machine, which holds about two charges. The condensers are of the vertical water-cooled tubular type, of a capacity of 1½ million cubic feet per day. There are two steam-driven exhausters, of 50,000 and 70,000 cubic feet per hour respectively; and the Livesey and rotary washers deal with 1½ million feet a day. Purification is carried out with seven boxes—three of which are 30 feet by 20 feet, and four 20 feet by 16 feet; the latter being worked in pairs. The gas flows through a station-meter passing 80,000 cubic feet per hour into the holders, of which there are three, having a combined capacity of 1,100,000 cubic feet. Here, again, the visitors were fortunate on Saturday, for they were able to inspect one of the gasholders—of a capacity of 450,000 cubic feet—under repair. The cupping was leaking; and as a preliminary to replating the faulty portion of the inner lift, the tank was emptied—an operation which occupied some three weeks.

The carburetted water-gas plant is of Messrs. Humphreys and Glasgow's make; the capacity being 500,000 cubic feet per diem. It is fitted with air and steam meters, pyrometers, and all other modern devices for securing exactitude in working. There are storage tanks holding 300 tons, into which the oil flows by gravitation. It leaves the tanks in the same manner, and then is forced to the water-gas house by steam pressure—all pumps being dispensed with. Everything is absolutely closed in; and there is an absence, therefore, of smell of oil. At present the coke is raised to the charging stage in buggies by a lift; but later on it is intended to extend the telpher track into the house—which can be very easily done, as it is near the retort-house. This will save wheeling the coke and the subsequent use of the lift.

There was but little time to spare in the excellent cooker repairing and fitting shops, where every necessary appliance has been installed; but it was seen that very good work is turned out here. Passing along, a few moments were spent at the plant for curing naphthalene troubles. In connection with this, it was explained that a portion of the gas after it leaves the purifiers is made to bubble up under a circular plate having serrated edges into a tank containing a quantity of Brotherton's light solvene. There are 6-inch connections for the plant, with a 20-inch main; and the reason only a portion of the gas is passed through the apparatus is to obviate back-presssure. The plant is only being used in the summer; and it is intended to enlarge the connections to 12-inch, so that all the gas made may be passed through it without back-pressure. Practically no trouble is now experienced with naphthalene; whereas there used to be some complaints before this system was put into operation. The duplicate boosting plants of 120,000 feet per hour each, were inspected; and it was learned that boosting is resorted to at lighting-up time, as well as sometimes about mid-day on Sunday, when there is a big demand for gas for cooking purposes. Other items of interest were the sulphate of ammonia plant (to which a 2-ton Wilton saturator has just been added), and a Wilton tar dehydration plant. The tar produced at the works is either loaded into boats on the canal adjoining the works by gravity from the sales tank, or pumped up from the well and put through the process of dehydration. In the latter case, the tar is heated under a pressure of 30 lbs., and is then conducted to a receiver where the pressure is released, and the light-oils and water come off as vapour. The dehydrated tar

is then taken to storage; and the light-oils are condensed. There is a good demand for the prepared tar for roads; something like 1000 tons a year being disposed of in this way.

The inspection concluded, the party proceeded to the Town Hall buildings, where they were the guests of Mr. Charles Webb at high tea.

The PRESIDENT remarked that a vote of thanks was due to Mr. Webb for the manner in which he had entertained the members that afternoon, and also to the members of the Gas Committee for granting them permission to go over the gas-works. The visit was one which he personally had looked forward to for some considerable time. They all knew that Mr. Webb stood very high in the gas profession; and any work he had been associated with had always been done well. They had seen an up to-date gas-works, where the carbonizing results were equal to anything that was being obtained at the present time. The manner in which the work was done showed that not only was Mr. Webb able to erect good plant, but he was also able to gain the confidence of the men who worked under him. These men, like Mr. Webb himself, were determined to give the best results to the town of Stourbridge and the consumers generally. It was very pleasant to see such loyalty—especially in these times of actual and threatened labour troubles. What had been accomplished in connection with the Stourbridge gas undertaking must be very gratifying to the Council and the ratepayers. The capital expenditure had been reduced considerably; and at the same time the price of gas had been brought down to a very low figure, which no doubt had been the means of increasing the consumption of gas from 96 million cubic feet in 1892 to 249 million feet last year. They had had a very enjoyable and instructive afternoon; and in thanking Mr. Webb, they must not forget his assistants, who had also neglected no opportunity of imparting information. There had been many things to see at the Stourbridge Gas-Works.

The SENIOR VICE-PRESIDENT (Mr. F. J. Ward, of Knowle) seconded the vote. He said that, like the President, he had keenly looked forward to the visit; and his anticipations had been amply fulfilled.

The members showed their appreciation of what had been done for them, by the cordiality with which they passed the vote.

Mr. WEBB, in returning thanks, said he would like to take the opportunity of congratulating the President on his recent promotion to West Bromwich. If the visitors had been interested in what they had seen, both he and his assistants were more than repaid for anything they had done. Mr. Fred. North—the son of Mr. William North, who was his (Mr. Webb's) predecessor at Stourbridge—was the Chairman of the Kinver Gas Company; and he considered the ride they were about to take to Kinver was a sort of visit to the Kinver Gas-Works, which made a million cubic feet per annum. Mr. North had therefore very kindly undertaken to entertain them to the tram ride to Kinver and back.

Mr. FIDDIAN expressed his pleasure at being present, and trusted the members would go away with a feeling that they had benefited from what they had seen at the works. Although the works were not by any means new, he thought they were quite up-to-date in the methods adopted; and for this thanks were largely due to their excellent Engineer, Mr. Webb. He was sure that the more the members knew of Mr. Webb, the more they would, like the people of Stourbridge, appreciate him. He welcomed them on behalf of the Council, and hoped that when next they came to Stourbridge they would be welcomed by a Mayor and Corporation.

The party then proceeded to Kinver by tram-car, subsequently returning by the same means to Stourbridge. The trip through pretty and interesting country, in perfect weather, was extremely pleasant, and fittingly brought to a close a thoroughly successful outing.

WAVERLEY ASSOCIATION.

Ninety-Eighth Annual Meeting at Edinburgh.

The Ninety-Eighth Annual Meeting of the Waverley Association of Gas Managers has come and gone. What struck the seniors present as a sign of the times was the ease of manner and speech of the younger men of the profession, and the ability to express themselves clearly and to voice their ideas in public without apparent effort or nervousness. Time was when only the hardened veteran would rise to his feet at a meeting; and when any one less experienced desired to ask a question or mention some piece of work, it was done with an evident wish to get it over and done with. Now the practice and experience gained in Junior Gas Association meetings—and in many towns where the distance is too great for the very frequent attendances at gas meetings, the joining and taking part in the work of debating societies—has given the younger men just that practice and power to find suitable words for the expression of their ideas that is improving, and will more and more improve the work of these Associations. Many years ago Sir Corbet Woodall advised the writer to join a certain society connected with engineering, not for the information to be gained there, but because in the course of the discussions one would hear statements made which could so easily be controverted that one would get up without fear to point out to the previous speaker the error of his ways, and so obtain the necessary experience of discussion and speaking in public.

Mr. A. Masterton reminded the members that the centenary of the Association would occur in two years' time, and that some special effort should be made to mark so unique an event. We have had the celebration of a hundred years of gas making and of the hundredth year of a gas company's existence; but the centenary of a gas association has et to be recorded. The honour of being the oldest gas association in the world belongs to the Waverley Association; and it is fitting that something very special should be done to celebrate the event. One thing at least might help to increase the interest on the occasion—namely, the attendance of as many of the old members who have been called out of the district as can manage to spare the time to travel and again take part in the discussion and to assist in the harmony of the proceedings. This rests with the former members; and no doubt the Secretary will see that they are all invited. The President for the year should also be chosen from those high up in the profession who are eligible according to the rules. Whether the rule as to the holding of the meeting in Edinburgh should be changed so that a visit could be made into the Waverley country or not requires some thought. Possibly a two days' meeting could be arranged for such a rare event. The first could be spent in the reading of an address and discussion; and the usual dinner afterwards; while the second day might be given up to visiting several towns in the Scott country and examining the gas-works in these places. No doubt a Special Committee will be formed to consider and arrange the best method of making this centenary worthy of the occasion; and the members of this Committee might be chosen partly from among those who are not eligible to serve on the usual annual Committee.

The courteous message from the Directors of the Company which the President serves reminded one of the olden days when the meetings took place invariably in the town where the President resided. The proceedings always included a visit to his works and a sight of those little experiments or improvements which he had accomplished or had under way. Much was learnt and many little dodges noted for future use. Could not such visits be still carried out, despite the rule that the meetings are to be held in Edinburgh, by the arrangement of an autumn meeting in September or October, at the town where the President carries on his work?

Mr. Easson's address was excellent. He touched upon many subjects which would have provided for a much longer discussion than actually took place, owing to the necessity of dining early so as to catch the special train to Granton in order to be in time for the drive and to catch the workmen's train back again after the inspection of the works and the discussion of the Gas Commissioners' hospitality. Mr. Easson explained in his reply to the discussion how his figure for the number of hours of light obtainable from petrol gas was ascertained; but the acceptance of the amount of light given by any burner which is only judged by the eye is not sufficient for a tabulated statement. It would be a pity if too high a figure should be given to any illuminant, owing to such a method of estimation.

The President's remarks on the effect on the price of gas of a percentage reduction in the price of coal might be more simply stated in these days of 10,000 cubic feet per ton production, as that 10d. per ton is equivalent to 1d. per 1000 cubic feet in the price of gas—other things, of course, being equal. While on this question of 10,000 cubic feet per ton to which he referred, and which other speakers apparently concluded the President was making, it is not so stated in his address. His remark: "Are we extracting all (the ammonia) we ought to extract"? is a good question to keep before our minds. In fact, the query might be put about all the products of the coal, and then perhaps we shall in time arrive at the large production of gas referred to at the meeting. Whether this is only possible by means of vertical retorts is questionable; and many of the company who visited Granton in the afternoon voiced their mind that the automatic action of the slopers left few advantages to the vertical retorts. It must be remembered that any increase in the quantity of gas must always be at the expense of some of the residuals, or due to a lowering of the illuminating and calorific power of the gas itself. We are, however, a long way from the explosive mixture spoken of by Mr. Easson, while we have to take four or five times the bulk of the gas in atmospheric air to support the combustion of the gas. If this quantity of air were sent out with the gas, it would be quite non-luminous, and therefore would at once give evidence of its dangerous nature.

It was a good notion to introduce a plan of the Jedburgh Gas-Works into the address, as it added to the interest of the remarks made regarding the works. Several useful cautions were given by the President, such as the keeping of the percentage of the air below 3 per cent. at the purifiers, the careful mapping and coating of steel mains, the saving of money frequently expended on trying to beautify works, the avoidance of naked lights about the works, and the advantage of reducing the cost of the gas. All these may be taken to heart by gas managers, as may also the question of the supply of electricity from gas-works in those towns where there is a market for the current but not room for two suppliers of light. The meeting (a full report of the proceedings at which, together with the Presidential Address, is, owing to other claims on our space this week, unavoidably held over until our next issue) was a satisfactory and profitable one; and Mr. Easson is to be congratulated on his address, his conduct in the chair, and the general arrangements which have marked this ninety-eighth meeting of the Waverley Association of Gas Managers.

The forty-first annual general meeting of the Swiss Association of Gas and Water Engineers is fixed to take place from the 29th to the 31st of August in St. Gallen. The full programme is not yet announced.

DETERMINATION OF AMMONIA IN ILLUMINATING GAS.

In a recent issue of the "JOURNAL" [*ante*, p. 502] attention was called to a Technologic Paper issued by the United States Bureau of Standards, containing the results of a brief investigation of the apparatus and methods employed for the commercial determination of ammonia in illuminating gas. We have since received a copy of the paper, which is by Mr. J. D. Edwards, Laboratory Assistant to the Bureau [No. 34 of a series specially dealing with methods for testing and analyzing gas], and are therefore able to give a fuller indication of its contents.

After some general considerations, the subject of the choice of indicators is taken up. It is pointed out that many indicators are still commonly used which are not at all suited to the purpose, as they fail to meet one or more of the following essential requirements: The indicator should (1) show a sharp end-point in dilute solutions; (2) it should be sensitive to ammonia, and not be seriously affected by ammonium salts; and (3) the end-point should be affected as little as possible by carbon dioxide. An investigation was made of the indicators frequently used and of some others which, for theoretical reasons, seemed likely to give good results; and a tabulated comparison of them is given. Those found to be most suitable were sodium alizarinsulphonate, cochineal, and para-nitrophenol. The presence of the glass beads which are used in some of the absorption apparatus may lead to erroneous results for two reasons—the beads may yield alkali on contact with the absorbing liquid; and the washing of the beads may be incomplete. Remarks are offered on the errors due to these causes; and then an account is given of the tests of the apparatus. This is reproduced below.

Tests of Apparatus.

1.—Description of Apparatus.

Various forms of gas wash-bottles have been used for absorbing the ammonia; but a few special types have best met the conditions of service and come into practical use. The following five forms have been considered in this paper.

(*a*) *Referees Apparatus.*—The Referees apparatus is the well-known form, first used by the London Gas Referees. It consists of a glass cylinder filled with beads and having stop-cocks at one or both ends. Some dealers are supplying this apparatus with metal cocks or connections cemented to the glass ends. But both the cement and the metal are quickly attacked by the acid, and make results obtained by the use of such apparatus unreliable.

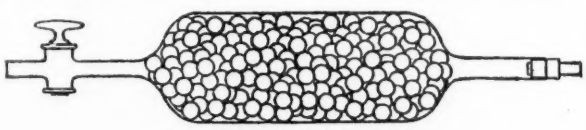


Fig. 1.—Gas Referees' Apparatus.

The form fig. 1 is that used in these tests. It was necessary to have a stop-cock at one end so that the apparatus could conveniently be held vertically when filling with acid. But the tube at the other end, which was used as the outlet, was made without a stop-cock and larger, so that acid and wash water could be easily introduced. In this outlet was placed a perforated rubber stopper carrying a glass tube.

(*b*) *Emmerling Tower.*—Although the Emmerling tower is also filled with beads, it is essentially different from the Referees form in operation; for the gas is required to bubble through the acid, while in the Referees apparatus it only passes over the surface of the acid. Emmerling towers are made in many different sizes and proportions; the one used (fig. 2) being of 2·2 cm. internal diameter and holding conveniently a bead column 10 cm. in length, which was found to give satisfactory results. The usual form is illustrated; but it could be better adapted for this particular purpose by placing the outlet tube on the same side as the inlet, or by using a glass tube in the rubber stopper as the outlet. Then there would be no danger of losing acid through the outlet if the apparatus was inclined too near to the horizontal.

(*c*) *Lacey Apparatus.*—This apparatus was primarily designed for travelling inspection work, and, being small and light, it is readily portable. The form and construction of the Lacey apparatus is apparent from fig. 3.

(*d*) *Modification of Cumming Wash-Bottle.*—This apparatus was designed at the Bureau of Standards for this work. (See fig. 4.) The object in view was to obtain a gas wash-bottle which would operate under low pressure, and yet give complete absorption and continuous circulation of the acid. Furthermore, it was so constructed that it may be permanently connected (as when used in series with the sulphur apparatus) and be filled and washed-out without changing any of the connections. The gas passing through the small nozzle acts like an injector, and circulates the liquid rapidly and continuously—thus bringing fresh acid into contact with the gas. Any colour change of the indicator can therefore be easily determined; for the liquid is very nearly of constant composition throughout the apparatus.

(*e*) *Wash-Bottle.*—The common gas wash-bottle was tested because its availability is a strong point in its favour when it is

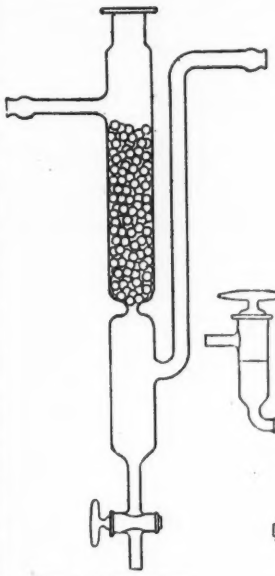


Fig. 2.—Emmerling Tower.

Fig. 3.—Lacey Apparatus.

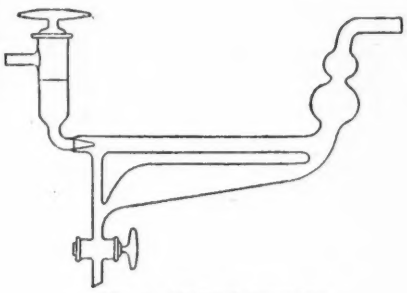


Fig. 4.—Modified Cumming Wash-Bottle.

to be used in gas inspection work where the other forms might not be obtainable. The form used (fig. 5) was of glass with a ground glass joint at the top; but one just as efficient can be easily made

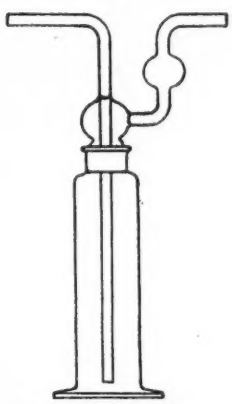


Fig. 5.—Wash-Bottle.

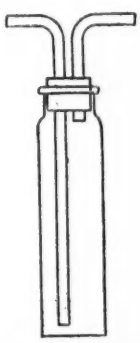


Fig. 6.—Wash-Bottle.

from a tall glass bottle, closed with a rubber stopper bearing an inlet and an outlet tube, as shown in fig. 6. The depth of liquid in the bottle, as well as the size and shape of the bottle, will affect the absorption; but the depth of liquid is limited by the gas pressure available for its operation. In the following experiments the bottle used had an internal diameter of 4 cm., was 18 cm. high, and the gas bubbled through 4 to 6 cm. of solution.

2.—Comparison of Apparatus.

(*a*) *Meter Comparison.*—For comparison, four different forms of apparatus were run at the same time from a common gas supply under as nearly uniform conditions as possible. The gas-meters employed were all of the wet type. Since only comparative results were desired, the meters were not calibrated, but compared with one another by running them in series. This comparison was repeated at intervals throughout the work, and the agreement found to be satisfactory—no change taking place large enough to have any appreciable effect upon the results. When only 1 or 2 cubic feet are used in a determination, the error incident to taking fractional parts of a revolution of the meter may be appreciable. It might amount to 1 per cent. of the volume of the gas if only 0·5 cubic foot is used. The effect of this error would, of course, be reduced by using a larger amount of gas.

(*b*) *Gas Supply.*—The regular city gas supplied to the Bureau was used, but in a large number of the runs ammonia was added to it, since its normal content is only about 1 grain per 100 cubic feet.* The ammonia was introduced into the gas by means of the following apparatus: A 30-litre bottle was fitted with a rubber stopper bearing two inlets and a stirring apparatus. The latter, consisting of a small fan inserted through the stopper and operated by a small electric motor, served to thoroughly mix the contents of the bottle. The gas was introduced through one inlet and a smaller amount of gas, which had passed through a

* Although it is the universal practice in America to express the results in grains of ammonia per 100 cubic feet of gas, these figures convey no adequate impression of the volume relation of the ammonia to the other constituents of the gas. One grain of ammonia per 100 cubic feet, measured at 30 inches and 60° Fahr. (762 mm. and 15·55° C.), is equivalent to 31·6 parts of ammonia per million by volume.

tube containing several lumps of ammonium carbonate, through the other. This latter gas bubbled through a small wash-bottle before passing through the ammonium carbonate tube, so that the amount of ammonia being introduced could be gauged approximately by the number of bubbles of gas passing per minute. The gas, after being mixed in the first bottle, passed through an outlet near the bottom into a similar bottle, through a narrow glass tube reaching two-thirds of the way to the bottom. The gas used was withdrawn from the top of this second bottle and distributed through a system of T-connectors, delivering the same quality of gas to each apparatus. All connections were made as far as possible by means of glass tubing held together by short pieces of heavy walled rubber tubing.

(*c*) *Absorbing Liquid.*—An approximately N/50 solution of sulphuric acid, standardized by precipitation with barium chloride, was used as the absorbing agent.

For titrating the excess acid, a solution of sodium hydroxide of approximately equivalent strength was used; the exact ratio between it and the acid being obtained by titration in the same volume of solution as during an actual determination.

It was not considered desirable to use a stronger solution of acid because of the small amount of ammonia to be absorbed, and the fact that small errors in the measurement of stronger solutions make a large error in the ammonia apparently absorbed. Should it be desirable to extend the operation over long periods of from ten to twenty hours, in order to obtain an average for that period, it may be necessary to use a stronger acid solution. The amount of ammonia likely to be absorbed is the factor which should determine the strength of acid to be used. Other conditions being equal, the greatest accuracy is obtained when the major part of the acid in the apparatus is neutralized by the ammonia in the gas.

(*d*) *Operation of Apparatus.*—About 25 cc. of the standard acid was placed in each of the different forms of apparatus, except the Lacey, which required only about 15 cc. Then a small amount of water was added, to bring the solution in each up to the volume required for its most efficient operation. Connection was then made between the gas mixing-bottle and the apparatus; and a meter was connected to the outlet of each apparatus. All four forms were started at the same time; and the flow of gas to each was carefully adjusted to the desired rate. Although the rate fluctuated somewhat (owing to changes in the gas pressure, no governor being used), it was maintained as nearly uniform as possible by close observation and regulation. The rate given in the table is the average rate for the whole run.

except with the Lacey apparatus in tests 1 and 2, where gas was passed through the apparatus until the change of colour of the indicator showed saturation of the acid by the ammonia.

It is seen from a consideration of these results that those obtained with the Emmerling tower are somewhat higher than those obtained with the other forms, and that the wash-bottle gives results consistently lower. The other three ran about the same.

In order to determine whether any appreciable amounts of ammonia escaped unabsorbed, a second series of tests was made—see tables. In these tests the gas, after leaving the first absorption apparatus, passed through an Emmerling tower, the acid in which was then titrated as usual. Since the gas receives a very thorough washing in its passage through this apparatus, it is reasonably certain that any ammonia escaping absorption in the Emmerling tower thus used must be a very small percentage of the total, and in any case entirely without interest as affecting the quality of the gas. As seen in the table, in all but two of the experiments the amount of ammonia thus absorbed in the Emmerling tower was not detectable within the limits of error of the titration.

*Tests of Completeness of Absorption.**

First Absorption Apparatus in Series with Emmerling.	Rate of Passage of Gas, Cubic Feet per Hour.	NH_3 Grains per 100 Cubic Feet.	NH_3 in Emmerling, Grains per 100 Cubic Feet.	Percentage of NH_3 absorbed in Second Bottle.
Lacey	0·62	9·64	0·0	0
	·66	21·65	·2	1
Referees	·60	25·60	·0	0
	·66	8·50	·0	0
Modified Cumming	·52	15·20	·0	0
	·57	5·34	·0	0
Wash-bottle	·61	4·26	·0	0
	·57	4·53	·1	2

* Titrations made with sodium alizarinsulphonate as indicator.

3.—Conclusions and Recommendations Regarding Apparatus.

The accuracy obtained in practice will, of course, depend upon the accuracy with which the gas is measured, the certainty with which the ammonia equivalent of the acid is known, and the completeness of absorption of the ammonia. With careful operation, any one of the five forms of apparatus tested would ordinarily give results that are well within the limits of accuracy required for this determination, either for commercial control work or for

Comparison of Ammonia Absorption Apparatus [*Sodium Alizarinsulphonate Used as Indicator*].

Test Number.	Time of Run, Mins.	Average NH_3, Grains per 100 Cubic Feet.	Lacey.			Modified Cumming.			Wash Bottle.			Referees.			Emmerling.		
			Rate, Cubic Feet per Hour.	NH_3, Grains per 100 Cubic Feet.	Variation from Average, per Cent.	Rate, Cubic Feet per Hour.	NH_3, Grains per 100 Cubic Feet.	Variation from Average, per Cent.	Rate, Cubic Feet per Hour.	NH_3, Grains per 100 Cubic Feet.	Variation from Average, per Cent.	Rate, Cubic Feet per Hour.	NH_3, Grains per 100 Cubic Feet.	Variation from Average, per Cent.	Rate, Cubic Feet per Hour.	NH_3, Grains per 100 Cubic Feet.	Variation from Average, per Cent.
1	60	20·50	0·5	19·48	− 5·0	0·5	20·91	+ 2·0	—	—	—	0·5	20·36	− 0·7	0·5	21·24	+ 3·6
2	85	12·25	·54	12·42	+ 1·4	·56	12·34	+ 0·7	—	—	—	·50	11·98	− 2·2	·54	12·26	0·0
3	70	11·68	·6	11·81	+ 1·1	·6	11·74	+ 0·5	0·63	11·52	− 1·4	—	—	—	·65	11·65	− 0·3
4	100	6·81	·65	6·78	− 0·4	·5	6·74	− 1·0	—	—	—	·5	6·82	+ 0·1	·5	6·90	+ 1·3
5	90	6·42	·61	6·46	+ 0·6	·62	6·44	+ 0·3	·57	6·31	− 1·7	—	—	—	·60	6·46	+ 0·6
6	120	5·33	·78	5·45	+ 2·2	·57	5·26	− 1·3	·64	5·23	− 1·9	—	—	—	·68	5·38	+ 0·9
7	120	3·85	·77	3·77	− 2·1	·66	3·77	− 2·1	·72	3·72	− 3·4	—	—	—	·73	4·13	+ 7·3
8	120	3·66	·53	3·67	+ 0·3	·53	3·55	− 3·0	—	—	—	·56	3·77	+ 3·0	·51	3·66	0·0
9	60	2·69	·60	2·79	+ 3·7	·60	2·72	+ 1·1	·61	2·60	− 3·3	—	—	—	·60	2·65	− 1·5
10	270	·80	·63	·79	− 1·3	·62	·80	0·0	·59	·77	− 3·8	—	—	—	·64	·83	+ 3·8
11	60	6·38	1·10	6·34	− 0·6	—	—	—	·98	6·38	0·0	1·03	6·40	+ 0·3	1·05	6·38	0·0
12	60	3·99	1·00	3·90	− 2·3	—	—	—	·98	3·90	− 2·2	1·01	4·14	+ 3·8	·97	4·00	+ 0·2
13	105	·95	1·00	·92	− 3·1	—	—	—	—	—	—	1·01	1·01	+ 6·3	1·01	·93	− 2·1
Average, 1 to 10.	—	—	—	—	+ 0·5	—	—	− 0·3	—	—	− 2·6	—	—	+ 0·05	—	—	+ 1·6

(*e*) *Results of Comparison.*—The table shows the results of thirteen runs with gas of varying ammonia content. The data for each run are arranged in a single line, designated at the left by the number of the test. All results secured are recorded, with the exception of two runs where irregularities of operation interfered and made the results valueless, despite the fact that fair agreement was secured. The value recorded in column three, "Average NH_3, Grains per 100 Cubic Feet," is obtained by averaging the four results obtained with the different apparatus. The values in the column headed "Variation from Average" are the differences between the average and the value secured with the particular apparatus expressed as a percentage of the average. While the average value may be no nearer the correct value than any of the four individual results, it affords a convenient means of comparison, and the results indicate the general tendency of the different forms of apparatus. The average variation from the mean, as shown at the foot of the table, is only for tests 1 to 10; since the last three were made at a much higher rate, and are not comparable, therefore, on the same basis as the others. Two different Referees apparatus were used, identical in shape, but one slightly smaller than the other. Tests 4, 11, 12, and 13 were made with the smaller apparatus. Sodium alizarinsulphonate was used as the indicator, and the excess acid titrated in every case

the purpose of gas inspection.* The wash-bottle appears to be slightly less efficient as an absorber than the other forms; but still it gives satisfactory results. Any increase in the accuracy which might be secured by a more complete absorption train and the removal of interfering gases would not generally be practicable because of the increase in time and labour involved.

Referees Apparatus.—Balancing the possible loss of acid due to neutralization by alkali from the beads or by retention of acid after washing is the possibility of ammonia escaping from the Referees apparatus—a danger somewhat greater than with other forms, because the gas passes over only the wet surface of beads and cylinder and may quickly saturate the acid exposed without neutralizing the main bulk of liquid in the bottom of the apparatus. It was frequently observed, when an indicator had been added to the acid, that the beads along the top had changed colour, because of saturation by the ammonia of the liquid adhering to them and

* It is difficult to make any comprehensive statement defining satisfactory results. In general, results on gas containing up to about 5 grains of ammonia per 100 cubic feet should be within 10 per cent. of the ammonia content of the gas, although the percentage error may be greater when the ammonia is 1 grain or lower. With gas containing more than 5 grains of ammonia, the percentage of error should decrease somewhat. The interpretation of results is discussed in Bureau of Standards Circular No. 48.

that this colour change sometimes extended to the outlet—the bulk of the liquid being still unaffected. Owing to the solubility of the ammonia in water, there may be no loss even after the surface liquid has become saturated; but it is believed that ammonia sometimes escapes this way. The cylinder should be rotated from time to time, to moisten the top beads with fresh acid. The cylinder should also be completely filled with beads, so that there is small opportunity for the gas to follow channels and so escape thorough washing. At higher rates, up to 1 cubic foot, the Referees apparatus gives better absorption than either the Lacey or the modified Cumming. The Referees apparatus, as noted in a previous paragraph, should be made without metal parts; and the outlet is best closed with a rubber stopper carrying a glass tube. As this apparatus is clumsy to handle, it is not recommended for travelling work. However, it operates with very small difference of pressure between inlet and outlet, which is frequently a great advantage—particularly when being used in series with a sulphur apparatus.

Emmerling Tower.—The Emmerling tower seems to give somewhat better absorption than the other forms. Since only a small column of beads is used, it can be easily washed by bubbling a little air through to agitate the wash-water covering the beads. The same attention should be paid to the resistance to solution of the beads used as with the Referees apparatus. The principal objection to the Emmerling form is the fact that it requires a larger pressure to operate than some of the other forms. The pressure necessary depends, of course, on the amount of liquid in the apparatus and the angle at which it is inclined. In addition to its efficiency as an absorber, another point in its favour is the fact that it can be filled and emptied without breaking the connections. It may be used at higher rates—say, 1 cubic foot per hour—with safety.

Lacey Apparatus.—The Lacey is a satisfactory form to use; it is light and easily portable, being especially adapted for travelling inspection work. The circulation of acid is often poor, and when a test is being run to determine whether saturation of the acid has taken place, it is necessary to mix the contents of the bulbs thoroughly before a reliable observation can be made. The Lacey should be so filled and set that the gas is required to bubble past each of the constrictions. Care should be taken that loss of acid does not occur by bubbles breaking too close to the outlet. The gas should be passed at about 0·6 cubic foot per hour.

Modified Cumming Apparatus.—This apparatus will give good absorption when run at a rate of 0·6 cubic foot per hour or less. The circulation of the liquid is excellent, and any change of colour can be easily observed. The pressure required to operate it is low. It can be permanently connected—being emptied and filled without changing the connections, which makes it very convenient to use in a permanent set up in series with a sulphur apparatus.

Wash-Bottle.—The wash-bottle is evidently not quite as efficient an absorber as the other forms. Where an accuracy of 10 per cent. is sufficient, the wash-bottle may be found useful because of its availability. The bottle should be tall and narrow; the amount of acid being used depending on the pressure available for its operation. Two bottles in series may be used where greater accuracy is desired. They will require greater pressure to operate, which may prevent their use where the pressure is low. Gas should be passed at a rate not greater than 0·5 to 0·6 cubic foot per hour.

Summary and Recommendations.

Four common forms of apparatus for the determination of ammonia in gas, and a new form designed on the principle of the Cumming wash-bottle, were tested. The results show that the amount of ammonia in a gas can be determined with sufficient accuracy for official or commercial testing with any of the five forms. The advantages and disadvantages of each form, as well as precautions to be observed in operation, are pointed out in the text.

It is recommended that the ammonia be determined by absorption in sulphuric acid with subsequent titration of the excess acid, and not by passing gas through the apparatus until a colour change is shown by the indicator. It is satisfactory, however, when it is only desired to know whether the ammonia content is above or below a certain limit, to pass a predetermined volume of gas and note whether the acid has been completely neutralized or not.

Sodium alizarinsulphonate, cochineal, and paranitrophenol have been found to be satisfactory indicators.

The use of a N/50 solution of sulphuric acid as an absorbing agent is recommended, although the strength may be varied to meet different conditions.

The errors due to incomplete washing, and the use of glass beads are discussed, and means of eliminating their effect are given.

INSTITUTION OF WATER ENGINEERS.

Summer General Meeting at Stockport.

THE Nineteenth Summer General Meeting of the Institution was held last week at Stockport, where Mr. THOMAS MOLYNEUX, Assoc.M.Inst.C.E., the newly-elected President, is in charge of the modernized water undertaking of the Corporation. As usual, an elaborate programme had been compiled to fill in the three days, with discussions, visitations of inspection, and occupations of pleasure. As was the case in regard to the Wakefield meeting last year, Stockport not being a highly-developed town in regard to the matter of hotel accommodation, the members of the Institution were almost entirely housed at a distance. The headquarters of the Institution was the Midland Hotel, Manchester. There was, however, no material disadvantage by effect of this residence at a distance from the conference room—the Council Chamber at the Stockport Town Hall—because the Manchester Corporation gave special facilities for conveyance by their tramcars to and from Stockport for all the occasions.

The business proceedings were opened on Thursday morning, when over 100 members and visitors assembled in the Council Chamber at the Stockport Town Hall, and the Mayor (Councillor Thomas Worthington Potts, J.P.) took the chair at half-past ten for the purpose of welcoming the Institution.

THE MAYORAL WELCOME.

The MAYOR, who on rising was received with applause, said his duty was of a very pleasant character. On behalf of the Corporation of Stockport he had to welcome the Association, and to say that the Corporation were very pleased indeed that the Institution had selected their town for the purposes of the summer general meeting. Of course, they realized that in selecting such a busy, industrial, manufacturing centre as Stockport they had not chosen it because it happened to be a health or pleasure resort. It was very far from that. Perhaps 150 or 200 years ago, when the River Mersey was a beautiful, pellucid stream flowing through an area of natural beauty, such as it was then, it might have been regarded as a pleasure resort; but the conditions of that time had had to give place to the progress of manufactures in the neighbourhood, and to-day Stockport was simply a very busy, industrial centre. Still, there were some things of which Stockport might justly claim to be proud. One was the magnificent Town Hall in which they were assembled; and he thought also that they might claim to be even more proud of their splendid water-works at Kinder. He dared say it was the attraction in this shape that had decided the Association's choice in selecting Stockport this year as the place of their annual meeting. They were to have the opportunity of visiting not only the Kinder undertaking, but also the Alderley reservoirs and the pumping-station and softening plant at Wilmslow, and the Lyme Park reservoir. They knew a great deal more about water-works undertakings than he did. Therefore he would say nothing in regard to these undertakings, but would leave them to form their own opinions; and he hoped that they would be benefited by what they saw. The Stockport Corporation felt proud that the Institution had selected their Water Engineer to be elected as their President for the ensuing year. They felt very proud indeed that the Institution should have conferred such an honour upon him, and thereby, in some degree, given a little reflected glory to Stockport itself. He hoped they might have a very pleasant and profitable gathering, and that when they left Stockport they would be able to look back upon their visit with many pleasant memories.

Mr. C. CLEMESHA SMITH (the outgoing President), on his own behalf and on behalf of the members of the Institution, thanked the Mayor most heartily for the cordial and sympathetic welcome which he had given to the Institution. The Institution had as one of its main objects the widening of the experience and the increasing of the knowledge of its members with a view to rendering them more useful to the public whom they served. In addition to this, they wished to create a common meeting ground for all who were interested in any way in water undertakings and distribution. They would fail in their objects, however, if they were not assured of the sympathy of the large authorities who had to deal with the question of the supply of water. In past years they had received this sympathy, and that morning they had renewed evidence, in the reception which had been given to them by the Corporation of Stockport, that the municipal authorities were in entire sympathy with their aims and objects. He had to thank the Mayor, not only for his welcome to Stockport, but also for placing at the disposal of the Institution the beautiful Town Hall in which to hold their meetings, and also for giving them the opportunity of seeing the recently completed works at Kinder.

The Mayor then left the chamber; and Mr. CLEMESHA SMITH took the chair in his capacity of retiring President.

Presentation of Premiums.

The Chairman announced that the premiums awarded by the Council for papers read during the year were as follows: President's premium, value £10, awarded to Mr. W. J. E. Binnie and Dr. Herbert Lapworth, for their paper, entitled "Reservoir Storage in Relation to Stream Flow." Institution premiums of £5 awarded to Mr. W. T. Burgess, for his paper entitled "The Solubility of Carbonate of Lime;" to Mr. Alfred J. Jenkins, for his paper on "The Water Supply of Jersey;" and to Mr. R. Stevenson Henshaw for his paper on "The Portland Urban District Council Water-Works."

New Members and Associates.

The Secretary (Mr. Percy Griffith, M.Inst.C.E.) read the following names of members and associated members elected since the last meeting.

Members.—Mr. Prescot Hill, Manchester; Mr. Sidney B. Winser, Derwent Valley Water Board; Mr. Ernest C. Young, Tientsin, China; Mr. H. C. Adams, London; Mr. Arthur W. E. Fawkes, Calgary, Canada; Mr. Richard E. Tickell, London.

Associate Members.—Mr. Reginald C. F. Busfield and Mr. James C. Cruickshank, Aberdeen; Mr. Naunidh Rai Kapur, Cardiff; Mr. Sydney Reason, Antofagasta, Chili; Mr. Thomas H. Tyson, Halifax; Mr. George F. Anderson, Fylde Water Board; Mr. Charles Hall, Antofagasta; Mr. George H. Ivory, Mr. John H. Murphy, Manchester; Mr. Eric J. Wainwright, Stockport.

Associate.—Mr. George Smith, Eton Urban District Council.

Transfer to Class of Members.—Mr. T. Waddingham, formerly of Hebden Bridge, now at Grimsby.

Election of President.

The Chairman said he did not know whether any of the newly-elected members were present; but whether they were or not, he had great pleasure in offering them a hearty welcome to the Institution, and expressing the hope that their association with their fellow-members would be one that would combine continued pleasure and profit to themselves and to the members of the Institution generally. The next duty was to introduce the President for the ensuing twelve months. Mr. Molyneux had been a member of the Institution for a long period. He was one of the original band of men who founded the Institution—or, as it then was, the Association—in the year 1897. He had been a member of the Council for some years past, and by the regularity of his attendance and his strong common sense and the fearlessness with which he had supported his opinions, once he had convinced himself he was in the right, he had made a place for himself in the minds and hearts of his colleagues. He had no hesitation in saying that Mr. Molyneux would make an excellent President, and that his occupancy of the office would be one of pleasure to himself and advantage to the Institution at large. He had pleasure in asking Mr. Molyneux to accept a certificate notifying the fact of his election as President. He trusted the new President would have good health during the year, and would live long to retain pleasant memories of his period of office. Though it would be a year heavy with responsibility, it would have many pleasures; and he hoped that Mr. Molyneux, when he left the office, would be able to look back upon it without regret.

Thanks to the Retiring President.

Mr. Molyneux then took the chair, and said he was exceedingly delighted at the reception which Mr. Clemesha Smith's words had received from them all. He would endeavour to do his best to live up to the standard that the retiring President had fixed for him. He could assure them that he would use his best endeavours to forward the interests of the Institution. His next duty was to ask their support to the following resolution: "That the best thanks of the members of the Institution of Water Engineers be given to Mr. C. Clemesha Smith on his relinquishing the position of President." Mr. Smith was a gentleman whose urbanity had appealed to them all, and he had filled the office with dignity and honour. As a water engineer he had a record of which he might well be proud, and which would be fully appreciated by all. He went to Wakefield in 1897, when there was a rate-in-aid of the water undertaking of 1s. 5d. in the pound, and when the domestic consumption was 26 gallons per head. Since then he had succeeded in entirely wiping-out the rate-in-aid, and reducing the consumption to 18 gallons per head. Mr. Smith had held the office of President with entire satisfaction, and had presided at the meetings with courtesy and tact, and it had been a pleasure to sit under him. Their heartiest thanks were due to him, and he was sure they would all concur in his expression of the wish that he would long be spared after his retirement to continue to give the Institution the benefit of his valuable services in other directions.

Mr. Clemesha Smith acknowledged the vote, and said he had to thank them for the very hearty manner in which they had received the words spoken by Mr. Molyneux. When he was elected President he asked for the support of the Council and members generally, and any progress which might have been made in the Institution's affairs during his year of office was entirely due to the heartiness with which this support had been given to him. He had to thank the Council and the members very cordially for the attitude which they had adopted towards him during the past year, and he would particularly like to thank Mr. Griffith for his share in the work of the Institution. His work was far heavier than was apparent, and he did it faithfully and zealously, and in a way which showed that he had the true interest of the Institution at heart.

President's Address.

The President then delivered his

INAUGURAL ADDRESS.

After thanking the members for conferring upon him the highest honour they could bestow, he referred to the good record of work done by the Institution, as shown by the "Transactions," and urged the younger ordinary and associate members to submit to the Council details of their experience in the discharge of their multifarious duties. He pointed out that among the special subjects requiring further explanation and consideration is the use of steel pipes for water-works purposes, especially in the light of present-day controversy. That the Institution was making steady progress was shown by the increase in membership. In 1904 the total was 300; it is now 422, or 21 more than it was a year ago. The Institution had suffered the loss by death of five members, among them being Mr. Simmelkjœr and Mr. Easton Devonshire. The former was for some years the Hon. Auditor of the Institution; and the lateer was the Hon. Secretary. This position had been filled by the appointment of Mr. H. Ashton Hill, one of the Past-Presidents, who had lost a colleague by the death of Mr. F. Griffith, of Leicester. Having dealt with the more intimate matters concerning the Institution, the President passed on to relate a few of his personal experiences as a water engineer.

Watershed of the River Mersey.

The Stockport Corporation is, I believe, the latest, and may probably be the last, authority to utilize a fresh tributary of the River Mersey for water-supply purposes. There are to-day no less than 22 water authorities dependent entirely or in part (as in the case of Manchester) on the head waters of this river. These authorities serve a population of 2½ millions, and have expended about £11,000,000 in storage reservoirs (of a combined capacity of 12,465 million gallons), and in other works supplying upwards of 55 million gallons of water daily for domestic and trade purposes, and in addition between 30 and 40 million gallons per day as compensation water to the various streams the waters of which are impounded. The total area of gathering-grounds is something approaching 100 square miles, and there are also some 15 square miles utilized for the supply of canal reservoirs. Of the remaining gathering-grounds some are occupied by towns or villages, and on others suitable sites for reservoirs are not available.

The watershed, which is on the westerly side of the Pennine Chain and faces south-west, has a mean annual rainfall of about 45 inches; and as the rock formations are for the most part impervious, the yields, as compared with the rainfall, are high—in some cases as much as 90 per cent. of the rainfall flowing off individual gathering-grounds, and from 70 to 80 per cent. being quite common. The variation in the rainfall between the wet and dry seasons is surprisingly small, averaging only 1·4 inches; but that of the proportionate yield varies from an average of 94 to 54 per cent.

The reservoirs in the watershed are, in many cases, inadequate to provide for this variation, and were made intentionally so, as it was not considered advisable to store all the flood water, chiefly on account of the difficulty of rendering it fit for domestic use. It is a remarkable fact that in the early part of 1911—the last dry year in this part of the country—during the summer of which many of the water authorities had a difficulty in supplying the demands of their consumers, no less than 5000 million gallons of water passed to waste owing to the reservoirs being full; that is to say, a quantity sufficient to have supplied the whole population with a further 13 million gallons per day for a full year, or nearly half-a-million new consumers with 30 gallons per head per day for the same period.

These upland surface waters have, until comparatively recent times, been considered suitable for domestic use after sedimentation, without filtration; and the bulk of the water obtained from this watershed has been delivered to the consumer unfiltered. To-day, however, he is not satisfied with unfiltered water, and many authorities have been compelled by force of public opinion, backed up by that of the analyst and of the medical profession, to undertake the filtration of their supplies. Indeed, I have little doubt that in the near future the whole of the water supplies drawn from this source will be filtered.

We, as water engineers, cannot but be grateful that the mechanical filter has made this possible, as the older method of sand filtration would not only have entailed very great capital expenditure, but it is doubtful whether the large area of land required could have been obtained. Again, the result of sand filtration, though bacteriologically good, is not comparable, either chemically or physically, with that of mechanical filtration.

The results obtained by mechanical filtration with water considerably discoloured, and carrying large quantities of suspended matter, are such that it is well worth consideration whether the flood water which now has to be passed to waste, even in dry years, cannot be successfully treated, and so rendered available for ordinary domestic use; and seeing that, where gravitation works have been designed to take only a portion of the flood water, the watersheds are not fully reservoired, I think it is worth while considering whether, with the aid of mechanical filtration, and assuming that satisfactory reservoir sites can be found or existing reservoirs enlarged, it is not possible to greatly extend

the available resources of our present watersheds, and so postpone that expensive alternative, the amalgamation of the constituent authorities and the promotion of a scheme for bringing water from some distant source.

The equalization of the flow from the River Mersey watershed has also a further special interest, as the Manchester Ship Canal is entirely dependent upon it. The problem of finding water in dry seasons for the increasing traffic would be minimized if more of the flood water were impounded.

MECHANICAL FILTRATION OF UPLAND WATERS.

As this subject was so ably and exhaustively dealt with by Mr. Dixon at the last winter meeting,* and as I fully described our installation at Kinder in my paper on the Stockport works, I propose only to refer to a few details which have not, I think, been dealt with previously.

Before mechanical filtration is taken up on a much larger scale, the design of the plant will, I suggest, have to receive further consideration. The unit commonly in use is 8 feet in diameter, and capable of dealing with about 150,000 gallons of water per day; but there does not appear to be any reason, except mechanical difficulties which can undoubtedly be overcome, why the unit should not be much larger. There is already a plant in course of construction with units 9 feet in diameter; and experience will show how far this can be extended on the present designs. The cleansing of the filtering material, and the period for which it has to be dormant after washing, are probably the two most important factors which will need consideration. But the reduction in the number of units will tend both to economy in construction and reduced expense in working.

In my opinion also mechanically-filtered water would be further improved if, before being delivered to the consumer, it were passed into a service reservoir to allow a secondary deposition of matter in suspension, which no ordinary laboratory analysis shows, but which I think is undoubtedly present. The addition of the aluminoferric and lime to the raw water, the chemical action thereby involved, and the bacteriological and chemical changes produced by filtration, all take place so rapidly that I venture to suggest that the time allowed is insufficient for the completion of the various processes.

The analyses I have tabulated in my description of the Stockport works were obtained from samples of the water taken immediately it left the filters; yet deposition took place in the service reservoir into which the water flows, taking the form of a film on the bottom and on the lower portion of the walls. This reservoir had been in use eighteen months, and during this time 400 million gallons had been delivered from the filters through six miles of cast-iron pipes, and the water had stood, on an average, 24 hours in the reservoir.

I regard the action as, in some respects, analogous to the deposition which takes place after softening and filtering—an action which carbonating has frequently been introduced to counteract. An alternative cause of the deposit may be the action of the treated water on the cast-iron pipes, which, in some districts, has had the effect of loosening the corrosion, and causing serious disturbance of the water as delivered to the consumer for varying periods after the installation of mechanical filters. I am pleased to say that Professor Delépine, of the Public Health Laboratory, Manchester, has undertaken to give us the results of his research in this connection.

The cost of mechanical filtration varies with the quality of the water, which determines the quantity of chemicals needed. In the case of the Kinder water, the cost during the last twelve months has averaged 0·1d. per 1000 gallons, including wages of attendants and cost of chemicals. The amount of water used in washing the filters works out at 1 per cent.; but I consider that a certain proportion of this may be set off against that which would otherwise have been used to cleanse the mains.

It will also be interesting to observe the effect of mechanical filtration of water on the community at large. We all remember the controversy which at one time prevailed between advocates of hard and soft water; and we also know the detrimental effects which the medical profession attribute to the lack of mineral matter in moorland waters, to the action of such water on lead, and to the discoloration due to peat, all of which disadvantages are removed by this process. It must, therefore, be shown, particularly in districts formerly supplied with unfiltered water, to what extent mechanical filtration, with its chemical treatment, acts as a physiological or pathological factor in regard to the health of the community.

REINFORCED CONCRETE.

The use of reinforced concrete in the construction of covered reservoirs is an advantage, especially in regard to cost of construction. Though I have found that the cost of the concrete with reinforcement, when laid, is approximately the same as that of the bulk concrete, brickwork, or other similar material which would have been necessary, a great saving is effected in the reduced amount of excavation relative to a given capacity of the reservoir. Thus in a reservoir 20 feet deep, to hold 4 million gallons, which I have constructed, the cubical contents of the structure, including water space, when reinforced concrete is used, is 28,000 cubic yards, compared with 35,000 cubic yards if constructed of brickwork or bulk concrete; while the area covered by the reinforced concrete reservoir is from 15 to 20 per cent. less than that covered by reservoirs of bulk concrete or other material.

The extra cost of reinforced work per cubic yard is not only due to the steel reinforcement, but to the extra care which has to be exercised in the selection of the material to be used and the placing of it in position. As water-tightness depends not on several feet thickness but on inches only, the aggregate must be of exceptional quality and of carefully selected size and shape (it must not be of larger size than ¾-inch, and as near cubical as possible), the cement should not be less than one-seventh of the whole in bulk (not weight), and the timbering must be carried out by skilled carpenters—the ordinary timberman not being sufficiently trained. No doubt in course of time, as the use of the material increases, the timberman will become educated to the work, and highly skilled carpenters will not be required. It is also to be anticipated that as the reliability of reinforced concrete is proved by repeated examples, the period allowed by the Local Government Board for the repayment of loans will be extended. As so much depends on the quality of the work, I consider it advisable that it should be carried out by administration.

DISTRIBUTION.

The difficulties connected with the distribution of water are well illustrated in the Stockport area, where the levels vary from 120 to 160 O.D., and the water has all of it to be passed through the low-lying districts to the higher parts. A high and low level distribution would, therefore, be most complicated and costly. The service reservoirs from which the supplies are given are situated respectively at 770, 580, 450, and 475 O.D. That at 475 O.D. belongs to the Manchester Corporation, and it is possible to confine it to the supply of one district; but the remaining four-fifths of the supply has to be, to some extent, interchangeable as regards its area of distribution. The trunk main between the two higher reservoirs is therefore charged with water at a pressure which would be excessive in the districts supplied by the lower reservoirs. But, to enable the supply from the higher reservoirs to be utilized as required in the lower districts, the junctions of the two systems of mains are fitted with reducing valves, so that the pressure in the lower area is maintained equal to the static head of the lower reservoir, and the losses by friction are thus counteracted.

In some high districts, on the low-pressure supply, special provision for fire extinguishing is made by means of underground tanks. These are water-tight brick structures, placed under the footways in the proximity of large "risks," fed by direct connections with the water-mains—particular care being taken that the mains used are low pressure, and therefore not connected with sprinkler installations.

The cost of distribution is constantly increasing, due, in large measure, to improvements of road surfaces—such materials as tarred macadam, rock asphalt, granite setts grouted with cement, concrete beds, and even reinforced concrete beds, involving excessive cost in opening and making good. In some cases I have found that the reinstatement of the road surfaces has cost as much as, and even more than, the providing and laying of the main. Another difficulty is the ever-increasing number of conduits in addition to water-pipes, such as gas, electric light and power, telephones, telegraphs and hydraulic power, and the fixing of standards for electric lighting and traction. The footways are thus becoming so crowded that when the road surface is of such a nature as to be practically inaccessible for laying pipes, &c., special provision will have to be made in future town planning schemes for much wider footways to accommodate the various pipes, cables, &c. At the same time the authorities having power to lay such conduits will have to agree upon some definite system for adjusting their positions relatively to each other. This has already been done in the borough of Stockport as regards municipal supplies of water, gas, and electricity—each being laid at certain fixed distances from the building line.

CHARGES FOR WATER SUPPLY.

Water is the cheapest commodity with which the public are provided. In the case of cottage property, the amount paid is approximately only ¼d. per inhabitant per week. In the case of a house rented at (say) £30 a year, fitted with bath and water-closet, with the usual average of five inmates, the maximum amount paid per inhabitant is between 2d. and 3d. per week; in a house rented at £50, between 3d. and 4d. per week; and, even in the highest-rented houses, of (say) £200, only 6d. per week. Not only is the amount of water consumed per head increasing every year, but, by the wider meaning given by the Courts of Law to the term "domestic supply," the income of the water authorities throughout the country is being gradually, but materially reduced. The difficulty arises chiefly from the fact that the Acts of Parliament under which we work do not define what a "domestic supply" is, but, almost invariably, what it is not; so that any new demand which arises cannot, from force of circumstances, be in the exception, and is therefore liable to be ruled a "domestic supply." In regard to some recent decisions, I cannot refrain from remarking that when a consumer uses a domestic supply for the purpose of a profitable trade he should surely be liable for something over and above the normal charge made for a domestic supply.

It must not be forgotten that both municipal and company undertakings must charge sufficient for water supplied to meet the actual cost of providing, purifying, and distributing it. Therefore

* See "JOURNAL," Vol. CXXV., p. 237.

any serious reduction in the income from one class of consumers —as, for example, the trade consumer—must be met by increased charges on the other class (in this case the domestic consumer); and, therefore, adjustment of the charges should be based upon some equitable principle, and not be subject to the various decisions obtained in the Courts of Law.

CONSUMPTION OF WATER AND PREVENTION OF WASTE.

Experience in this district shows that the domestic consumption of water is between 20 and 21 gallons per head, and, as the whole of the district is sewered on the water-carriage system, this may be considered satisfactory. Actual measurement shows that, in cottage property fitted with water-closets, the consumption is from 8 to 9 gallons per head per day; and with baths in addition 13 to 14 gallons. In the highest-class property, where water is used for garden, horses and carriages or motor-cars, and similar purposes, 40 gallons per head per day are consumed; and in large institutions, such as industrial schools, the consumption is 30 gallons.

With the increasing cost of new works, owing to the gradual exhaustion of what may be termed local watersheds, the greater cost of distribution, and the gradual elimination of special charges, it becomes more necessary year by year to use constant vigilance in the matter of waste; and British engineers may well congratulate themselves that from 30 to 40 gallons per head per day are sufficient for all needs, as compared with the quantities our *confrères* on the Continent and in America have to provide—viz., from 100 to 150 gallons. In this connection, Stockport may claim some credit for having produced the first device for tapping water-mains without first of all emptying them of water—a device now in very general use.

The new "Model Code of Bye-Laws" recently issued by the Local Government Board, in the framing of which your Council —acting both in conjunction with the Joint Committee on Water Regulations and independently—took a prominent part, has improved our position in the restrictions which we can justifiably impose on the consumer in regard to waste and misuse of water; and I have hopes that in the future further headway may be made in this direction. Our members figure so largely on the Joint Committee on Water Regulation that I can confidently ask you to support to the utmost the work of this organization.

WATER DIVINING.

The water engineer has always had a deep distrust of those who claim to accomplish by intuition that which he can only do with some degree of certainty after years of study and experience; and I think that the result of the experiments which took place in April of last year, under the supervision of a scientific committee (which included two of our members) is worth recording. The Committee say "that whatever sensitiveness to underground water may exist in certain persons, of which some evidence has been given, it is not sufficiently definite and trustworthy to be of much practical value." This is a result which will surprise none of us, and should be convincing evidence that the engineer is the only one to be trusted to locate and secure a public water supply.

CONCLUDING REMARKS.

There are matters of extreme importance to which I have refrained from referring—such as the codification of existing Acts of Parliament, and the necessity for new legislation relating to water supplies; the appointment of a central authority to deal with the allocation and protection of sources of supply; the investigation of available sources of both upland and underground water; and many others. But they have already been ably put before you by my predecessors; and I have therefore advisedly restricted my remarks to my personal experience and opinions, in the hope that they may be of some value.

VOTE OF THANKS.

Mr. ASHTON HILL said they would agree with him that their new President had given them a very good, useful, and practical address, and one that would repay their thought and time in looking over it at their leisure. Like Mr. Molyneux, he had been a member since the start. He was sure they would agree with him when he said that Mr. Molyneux had served a very good apprenticeship, and that the experience which he had gained fully justified him in rising to the position he had now attained. He had known their new President all the time in connection with the Institution, and had always regarded him as a sound, level-headed man. Mr. Molyneux only needed behind him the support of the members in general in fulfilling the duties of his new office; and he would have undivided and earnest support from the members in that respect. He had great pleasure in proposing a vote of thanks to the President for his address.

Mr. MATTHEWS, in seconding the resolution, congratulated Mr. Molyneux upon what he regarded as an innovation, and one which he thought would be appreciated by everybody. In the early part of his address Mr. Molyneux had given them a summary of the work which had been carried out by Committees of the Council during the year, which had been almost in the nature of an annual report as to what the Council were doing. He thought that this was a very excellent thing to do.

The resolution was carried, and duly acknowledged by the PRESIDENT.

AN INVITATION REFUSED.

The PRESIDENT said he very much regretted to have to refer to an invitation which had been sent out by a certain firm inviting the members to visit their works in Cheshire. This matter had been before the Council of the Institution; and it had been decided that these arrangements could not be carried out without interfering with the programme for the summer meeting. It was therefore advised that on this occasion the invitation should be refused, because it was desired to secure the full attendance for Saturday morning's papers and discussions, and also—although no formal arrangements had been made for the members to visit the Manchester Engineers' Club, the Colliery Exhibition, and the Victoria Public Baths—it was hoped that members would take advantage of the invitations to these places in preference to going to works at a distance.

SOCIAL FUNCTIONS AND VISITS.

The members were then entertained to luncheon by the Mayor of Stockport in the Town Hall Banqueting Chamber, and immediately after luncheon left the Town Hall in motor brakes for Wilmslow, to see the water-works and the pumping and softening plant. From these they went to the Alderley reservoir, a feature of the visit to which was observation of some reinforced concrete work under construction. At the Alderley works tea was provided by the kindness of the President and Mrs. Molyneux. After tea the motor brakes were again available to take the visitors to the Midland Hotel, Manchester, where the annual dinner was to be held in the evening.

FRIDAY'S WORKS VISITS.

Friday was devoted entirely to the inspections of works. Motor brakes left the Midland Hotel, Manchester, at ten o'clock. The Kinder reservoir and filtration works, the main features of which are the embankment and the mechanical filters, were inspected in the morning. After luncheon, which was provided by the Corporation of Stockport, the party proceeded to Lyme Park reservoir, where they spent the early part of the afternoon. Thence the members passed to the works of Messrs. Mirrlees, Bickerton, and Day, Limited, and saw Diesel oil-engines under construction. After being provided with tea by the Company, the members returned to Manchester in the evening, when they had liberty to avail themselves of the opportunities afforded by the great northern city for their entertainment.

SATURDAY'S BUSINESS.

On Saturday morning the business meeting was resumed in the Council Chamber at Stockport, when the following three papers were read and discussed:

"The Character of Mechanically Filtered Water," by Professor Sheridan Delépine, of the University of Manchester.

"The Aëration and Filtration of Water for Swimming Baths," by L. Holme Lewis, M.I.M.E.

"Notes on Scraping a Fifteen-Inch Water-Main," by J. C. Barrowclough, of Batley.

VISITS TO WORKS.

Wilmslow and Alderley Edge.

On Thursday afternoon, the members, accompanied by the Mayor, the Mayoress, Alderman and Mrs. Johnson, and members of the Water Committee, visited the pumping-station at Wilmslow, and the reservoir in course of construction on Alderley Edge. Great interest was manifested in the pumping-station; and at Alderley Edge some time was spent in examining the reservoir which is being constructed on the top of the historic Edge, immediately below the famous beacon. The President was assiduous in giving explanations and answering questions; and all agreed that the ideas which he was putting into practice were the best that could possibly be conceived for the work in hand. Many difficulties had been encountered owing to the curious formation of the Edge; but all seemed to have been overcome in a skilful and efficient manner. After the inspection the party were entertained at tea by Mr. and Mrs. Molyneux, to whom a hearty vote of thanks was accorded.

Kinder Reservoir and Filtration Plant.

Arrangements were made for visits on Friday to the recently completed Kinder reservoir and filtration plant and to the Lyme Park reservoirs. Particulars of these works were furnished by the President in the form of a paper, which will be given in a subsequent issue of the "JOURNAL."

THE ANNUAL DINNER.

The annual dinner of the Institution was held on Thursday evening, at the Midland Hotel, Manchester. The PRESIDENT was in the chair, and he was supported by the Lord Mayor of Manchester (Alderman M'Cabe), the Mayor of Stockport (Mr. T. W. Potts), and aldermen, councillors, and officials of the borough, and others.

Mr. F. W. M'CULLOUGH, in proposing "The Mayor and Corporation of Stockport," said he was quite satisfied that the town was a progressive centre. The Corporation had their own gas, electric lighting, tramways, and water undertakings. They purchased the water-works in 1899, at a cost of three-quarters of a million sterling; and the new Kinder works cost another three-quarters of a million. The difficulties they had encountered in carrying through this scheme were almost insurmountable; and it was very creditable to the Corporation and the Water Committee to have succeeded in bringing it to so successful a termination.

The MAYOR OF STOCKPORT, in responding, said the town had had great difficulties to face, and one of them concerned the supply of water. When the members of the Institution saw the Kinder works,

he thought they would agree that the Corporation had overcome these difficulties in a very admirable manner.

Alderman JOHNSON, in proposing "The Institution of Water Engineers," referred with satisfaction to the election of Mr. Molyneux as President, and ventured to predict that the office would be well and worthily filled. Water engineers had, he said, to deal with a great and complex question; and he was satisfied that the meetings of the members of the Institution were of great advantage. Whatever might be thought of municipal trading, he considered there were certain services which ought to be controlled by municipal authorities, and water was one of them. They sometimes did not realize that water was one of the greatest essentials that man could have to conduce to his health and comfort. The Kinder scheme had been more costly than they had contemplated it would be; but, whatever the cost might be, he was convinced that it was necessary for a community to have a plentiful supply of pure water. He wished the Institution all success.

The PRESIDENT, in reply, said the Institution was a progressive one. They had a large membership, and members in all parts of the world. The Institution had been in existence nineteen years, and in a very short time they would be celebrating its twenty-first birthday; and he hoped they would then be able to do something which would bring them prominently before their fellow engineers. He thought their visits to different centres were of great benefit. By meeting together and discussing problems they were able to learn a great deal. In Manchester recently it was proposed that there should be an amalgamation of the whole of the engineering professions; and he assured those present that he would do all he could to assist in bringing about such an amalgamation.

The toast of "The Visitors" was proposed by Mr. C. C. SMITH, and responded to by the Lord Mayor of Manchester, Alderman C. H. BIRD, and Mr. H. BELL. The last-named speaker congratulated the Institution upon having at their head so good a man as Mr. Molyneux. They had known him at Stockport for many years, and had learned to appreciate him. He also congratulated the Institution upon the very good work it was doing. It was of great benefit, not only to water engineers, but to municipalities all over the country.

Gas, Electricity, and Water Supply in Tunis.

According to the accounts presented at the last meeting of the Company supplying Tunis with gas, electricity, and water, the past year's working showed an advance upon its predecessors. The increase in the quantity of gas sold was about 11½ million cubic feet, of electricity 128,348 kilowatt-hours, and of water 5¾ million gallons. There was a net profit of 514,153 frs. (£20,566) compared with 471,025 frs. (£18,841) before. The dividend was maintained at 55 frs. per share of 500 frs. nominal value. At the Company's new works there are in course of construction a gasholder of 212,000 cubic feet capacity, a purifier-house, and a retort-house on the Woodall-Duckham system, containing two settings of a producing power of 425,000 cubic feet per day. The Directors hope these new works will be in operation by the end of the year Additions to the water-works are under consideration.

Newcastle Gas Company's Jubilee.

In the course of a few days, there will occur the Jubilee of the incorporation of the Newcastle-upon-Tyne and Gateshead Gas Company. Gas was supplied in Newcastle long before 1864; but it was in June of that year that the Company obtained its first Act of Parliament; and additional powers were secured in 1867, 1873, and later years. The Chairman of the Company (Sir W. H. Stephenson) stated, a few months ago, that in 1864 the Company's sale was "240 million cubic feet, while last year it was 3290 million cubic feet." In many ways of production and sale, a local contemporary remarks, the gas industry has been revolutionized in the half-century; but in none is the change more marked than in the consumption of gas by slot meters. In the first year of the use of this method, the prepayment consumers numbered 168 only; now there are 68,000 prepayment consumers, and there are very many cooking stoves supplied with gas on the system.

The University of Wisconsin has recently published the results of some extensive investigations made with the object of determining at what temperatures tars are distilled from coal. The general conclusions are as follows: Tars commence to distil from any grade of coal at about 300° C. The maximum period of tar evolution is from about 375° C. to 475° C. The evolution is nearly always complete at 550° C., though continuing sometimes up to 600° C. The greatest amount of thick tars can be expected from coals which have a carbon-hydrogen ratio between 13·5 and 18. If the carbon-hydrogen ratio of any coal is known, it can be estimated fairly accurately what amount of tar will be distilled as compared with other known coals.

The annual general meeting of the Society of Chemical Industry will be held in University College, Nottingham, from the 15th to the 17th prox, under the presidency of Dr. Rudolf Messel, F.R.S. The business on the morning of the first day will include addresses by the President and Sir William Crookes (the President of the Royal Society), and the presentation of the Society's medal to the Right Hon. Sir Henry Roscoe, LL.D., F.R.S. In the afternoon there will be a visit to Southwell and a garden party at Brackenhurst Hall, by invitation of the High Sheriff of Nottinghamshire; and in the evening a reception at the Castle by His Worship the Mayor of Nottingham. Thursday will be devoted to visits to works—among others being the gas and electricity works of the Corporation; and on Friday there will be an excursion to the Dukeries.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

The Treatment of Prepayment Consumers.

SIR,—In your issue of June 2 [p. 644] you published a contribution from Mr. N. H. Humphrys on the above subject. It is a criticism of the paper I recently read at the meeting of the Eastern Counties Gas Managers' Association. It is very interesting and, on the whole, very fair.

Respect for its author compels me to offer some remarks upon it, although he makes it difficult for me to frame any adequate reply. He tells us that it is remarkable that our competitors, desirous of creating ill-feeling against gas and gas undertakings, should be assisted "with a weapon from inside the profession which will be used to the general detriment and discredit of our industry."

I entirely object to such a definition of the effect of the paper in question. At the same time, if I were to attempt to justify the statements it contains, I should be told that I was sharpening the said weapon for more effective use in discrediting the gas industry. I therefore content myself with saying that my paper stands as it was published; I withdraw not a syllable. It may be read in connection with the criticisms passed upon it; and your readers must be the ultimate and final judges upon the whole matter. There I shall leave it. In my opinion it will not injure our industry, nor add to the difficulties of my colleagues, as some of our timorous friends fear. Otherwise, I would not have written it.

Mr. Humphrys' able criticism contains much that will carry universal approval. But without appearing to be too sensitive, I may reasonably object to the suggestion that "the suspicion of dishonesty" was cast upon managers of gas-works, and to his allegation that I made a sweeping indictment against the industry of unfair treatment of the slot consumer. When he talks like this, he must read into my statement something far more than it expresses.

My innocent paper may be summarized thus:

1.—When the prepayment system was inaugurated, it was anticipated that certain extra cost would be involved in the supply of gas to this class of consumer.
2.—We were justified in fixing the extra charge at a sum that would fully cover the estimated additional expenditure.
3.—That those original estimates can now be tested by long and wide experience.
4.—That the time for revision had come, and, where possible, the prices should be adjusted voluntarily rather than in response to public demand.

I also pointed out that it is impossible to make any statement that would admit of universal application of what these extra charges should be, as local conditions vary so greatly; and I suggested that it might be difficult to justify them in many districts where they appear at the highest figure. That was the position I took up, and surely to say that a statement like that contains a sweeping indictment of dishonesty is to employ language that far exceeds the limits of moderation and reason.

This is all I wish to say in the way of criticism of Mr. Humphrys' communication. As he proceeds he makes one or two references upon which I may offer a word.

I quite admit that the desire to treat prepayment consumers justly is not limited to Lincoln, and the paper read was not indicted in any such pharisaic spirit. When it was written I was fully aware that in some towns they were treated more generously than in our case.

It is not correct to assume that the 4700 ordinary meters that have been replaced by slots have been scrapped. They have mostly been refixed, and are in profitable use.

It is the general custom in Lincoln for builders to pipe every house they build. In some cases the owners provide and fix the fittings; otherwise this is done by the tenants.

Notwithstanding Mr. Humphrys' remarks upon the relative costs of collection, I am quite clear that in Lincoln slots do not cost more than ordinary consumers. The charges in the latter case must include meter inspection, the keeping of meter books and rentals, the preparation and delivery of accounts, and collectors' salaries. In my case, these charges quite equal the costs involved in the collection from slot meters and the subsequent dealing with the money, together with all clerical work required in the office.

Whatever the costs may be that are involved in the service of the consumer, we all agree that they must be covered by the charges made upon him, whatever kind of meter he uses, and, after all that may be said, these charges must be determined by local conditions. I do not think that anything I have written is inconsistent with this elementary principle.

Mr. Humphrys, in conclusion, offers a statement of his own system for the information of your readers and for the purpose of giving me "an opportunity of retaliation." I can only congratulate him upon the success of his methods. He has adopted one or two ideas that are quite novel to me, and of which I have taken note.

I am not of a combative nature, and, even if I were, it would be difficult to find in Mr. Humphrys' system any occasion to retaliate.

Lincoln, June 10, 1914. JNO. CARTER.

An Old Friend—The Institution Meeting.

SIR,—I regret that my copy of the "JOURNAL" did not follow me to Brittany last week; and now I gather the sad news of the death of my old friend Thomas Newbigging, whom I knew for near on forty years.

I discovered, later, that he had a strong literary gift of quiet poetic vigour, usually expressing the best of North Country lore and bent of thought. He had modestly kept it to himself; but I rapidly collected and often received at his hands copies of his works.

He was a very thorough, practical, and safe engineer, of a class we

cannot afford to lose. May the earth rest lightly on him! One reminiscence of his quaint wit and force of illustration in the witness chair, under cross-examination, comes to me: "There is all the difference between a man scratching his head and tearing his hair out by the roots"!

Your list of his original and suggestive technical writings leads me to sympathize much with your "Editorial" on the coming session of the Institution of Gas Engineers. With no little concern, do I share your conclusions; and I am bound to confess some disappointment that there are so few papers of the engineering type, which I had hoped would be stimulated by the "London Medal."

We are, we know, to get a valuable contribution from Mr. Carpenter, whose earnest research work in illuminating combustion and in purification has enriched our industry, and will perpetuate his name when most of us are forgotten.

HY. E. JONES.

Palace Chambers, Westminster, S.W., June 12, 1914.

Field's Analysis and the Dublin Figures.

SIR,—Following my letter to you of to-day's date, yet a third interest is raised in your valuable number of the 2nd inst.; and that is the *résumé* of the fresh issue of "Field's Analysis," with the very important additions now given with it.

Your discriminating comments guide us to a direct appreciation of these new departures, but still more usefully point out where progress in results has been shown. The quiet, unpretending labours of the author deserve our best acknowledgments; for the work in compilation and careful study of the selection of facts must be very heavy. The book represents a value, especially to professional men, very far beyond its humble price. A correction may be required in remote places (as where the gross calorific value for Commercial gas should be stated at 525 not 472 B.Th.U.); but the whole forms a most reliable and complete record.

Your reference to my own comments on the Dublin accounts causes me to point out that, owing to the omission in the June half year of 1913 of a sum of income of over £3000, and also of its expenditure on distribution, the present record does not exactly agree with my figure of 2d. But to those familiar with accounts, it is obvious that the expenditure under "Heading 11," which has gone up from £2820 at June to £5819 at December, would have been some £3250 larger if "No. 12 Heading" had been given in the June account as receipts, which are put in December as £3243 8s. 9d. It is clear that there has been a suppression, beyond what I previously complained of, of a considerable amount of income and expenditure in the June half year; and while it is deplorable that the figures in "Field's" should have been in any way suppressed, a corresponding suppression of considerable sums from both income and expenditure in the actual account issued by the Company at June deserves the shareholders' most serious attention; and as I believe the Directors of the Dublin Company all of them to be high-minded gentlemen, I cannot think that such withholding of figures from the shareholders can have had their due consideration or sanction. It deserves certainly the consideration, if not the joint action, of the shareholders.

HY. E. JONES.

Palace Chambers, Westminster, S.W., June 12, 1914.

Gas Lighting at the Anglo-American Exhibition.

SIR,—It may interest your readers to know that the Brentford Gas Company have just installed a further number of high-pressure gas-lamps in the "Machinery Hall" at the above exhibition. The portion used for showing aviation displays and the general tourist portions have hitherto been lighted by electric arc lamps; but these have now been taken down, and in their place there is an installation of thirty-one 1500-candle power lamps. The result shows a striking improvement in the lighting of the building.

We are given to understand that it is intended to considerably extend this installation; and preparations have been made to that effect.

The installation of Keith compressors and "National" gas engines is on view to anyone interested in high-pressure lighting.

E. R. H. WINGFIELD, Chief Inspector.

Brentford Gas Company, June 11, 1914.

The Price of Tin.

SIR,—With reference to Mr. Edwards's letter, published in your issue of the 9th inst., it is not quite clear whose "ways" he considers should be "mended;" but I know of no article supplied to the gas industry, the price of which is controlled or manipulated in the same way as that of tin.

I understand that heavy fluctuations in the price of tin are caused, not by the action of the producers, or even by actual supply and demand, but by speculators on the Metal Exchange, who obtain control of the supplies, and create an artificial shortage, as a result of which prices are forced-up to abnormal figures, and the users of tin have to pay whatever may be demanded of them—even, as Mr. Edwards points out, as much as £230 per ton having been asked for metal which, owing to a sudden and unexpected drop, can at the moment (and, I I believe, only for the moment) be obtained for £140.

Unless tin remains at its present price for a considerable period, it will not be possible for the "firms supplying the gas industry" to obtain much, if any, advantage from its apparent cheapness, as, in order to protect themselves from sudden rises, and enable them to obtain materials at a uniform price and quality, it is customary for them to enter into annual contracts for their supplies of tin plates, &c.; most of such contracts being made at the beginning of the year. Thus a temporary fall in prices during the year affects them no more than a temporary rise would.

I believe most gas companies recognize that, of late years, manufacturers of all apparatus have had to contend with large increases in their wages bills and other manufacturing costs, including health insurance, increased insurance premiums against employers' liability, &c., and that, in consequence of these expenses, as well as of the higher prices paid for all materials (of which tin is only one item), any small increase which may have been made in the price of the manufactured article is only a matter of reasonable remuneration.

A MANUFACTURER.

June 12, 1914.

Calorific Power of the Commercial Company's Gas.

SIR,—I observe that, in Mr. Herring's letter on "Calorific Power in Relation to Candle Power," in your issue of the 9th inst., the calorific power of this Company's gas for the year 1913 is quoted from "Field's Analysis" as 472 B.Th.U.

Will you kindly note, in order to remove misapprehension, that this figure was the net B.Th.U., whereas other figures quoted are, apparently, gross B.Th.U.

Unfortunately, through an oversight, the net figure was supplied to the Compiler of "Field's Analysis," instead of the gross, which was 527 B.Th.U.

STANLEY H. JONES,
Engineer and General Manager.

Commercial Gas Company, Stepney, E., June 11, 1914.

Competition in Tenders.

SIR,—We were pleased to read the note on the subject of competition in tenders published by you on June 9 (p. 720).

Representing many corporations in Australasia, we continuously invite tenders for various descriptions of plant. We are imbued with the same sense of patriotism which is often forcibly expressed by our principals, and we cannot do better than quote a paragraph from a recent letter received from New Zealand from a corporation for which we are exclusively the representatives in this country. It may open the eyes of some of your readers to the earnest desire there so forcibly expressed to stick to the Old Country. Nevertheless, it is our duty to do our best possible in all cases: "It is not the wish of the Corporation to handle goods other than those of British manufacture, unless there is some very good reason for it."

Quite recently it was our business to invite tenders for gas and other plant; but, without entering into particulars, it was evident that we were face to face with a combination of British firms.

Our principals usually leave us free to accept or reject such tenders as we think desirable, without regard to any particular precedence or manufacture; and we are equally open in most cases to receive tenders from Continental firms. We wish it to be clearly understood that we give no answer to leading questions as to other firms quoting. The competition we invite is in all cases open to everyone.

We write in no invidious spirit; but we should like to see an open, healthy, and liberal competition in this country, which would exclude the necessity of going further. As an instance of the contrary, see Mr. Edwards's remarks in your last issue *re* the price of tin (p. 722). When we find there is, on the contrary, a painfully evident restriction among some British manufacturers, it becomes absolutely necessary to seek a remedy abroad, as in the case of the Tottenham Gas-Works.

WILLIAM COWARD, Managing-Director of
William Coward and Co., Limited.

100, *Bishopsgate, London, E.C., June 15, 1914.*

Leek Gas Management.—At last week's meeting of the Leek District Council, it was unanimously resolved that a testimonial under the seal of the Council expressing appreciation of the services rendered to the town by Mr. S. Trow Smith during the seven years he has been Engineer and Manager of the Leek Gas-Works be prepared and forwarded to Mr. Smith. The Chairman (Mr. Chas. Watson. J.P.) extended a hearty welcome to Mr. R. H. Ginman, the new Engineer and Manager, and expressed the hope that his association with the Council would be happy and successful.

Salford Gas Loans.—Mr. T. C. Ekin held a Local Government Board inquiry last Tuesday into an application by the Salford Corporation for power to borrow £70,000 in connection with the gas undertaking, of which £42,000 was to be spent on gas-cookers, and the remainder on fires, mains, meters, &c. The Local Government Board, it was stated, had already sanctioned loans of £7000 and £20,000, which had to be deducted from the £70,000. The Corporation also asked for sanction to borrow £7000 in connection with the erection of boundary walls at the gas-works. There was no opposition.

Accrington Street Lighting.—At last week's meeting of the Accrington Town Council, a proposal was defeated to rescind a minute instructing the Lighting Superintendent to discontinue lighting the side streets from May 4 until a date in August. The mover of the resolution said the action of the Council had resulted in the town becoming known for miles round as "Black Accrington." There were ratepayers all over the town who had met with minor accidents owing to the dark streets; and it was urgently necessary that the lamps there should be at once lighted. A proposal to instal a system of automatic lighting is under consideration.

Gas Appliance Show-Rooms for Walsall.—Discussion took place at the last meeting of the Walsall Town Council on a recommendation of the Gas Committee that two shops be taken on lease as a show-room for lighting, cooking, and heating appliances; and a letter of protest was received from the local Tradesmen's Association. Mr. Venables said the only object of the Committee was to demonstrate the uses to which gas could be put, with a view to increasing the output. There was no intention of competing with local tradesmen; and, indeed, it was felt that the course recommended would benefit tradesmen. Mr. Tucker moved that the matter be deferred for twelve months; and said it was "hitting below the belt" to rate tradesmen heavily and then compete with them in their business. If the shops were only required for the purpose of exhibition and demonstration, why did the Committee sell fittings at all? In the end the recommendations of the Committee were approved.

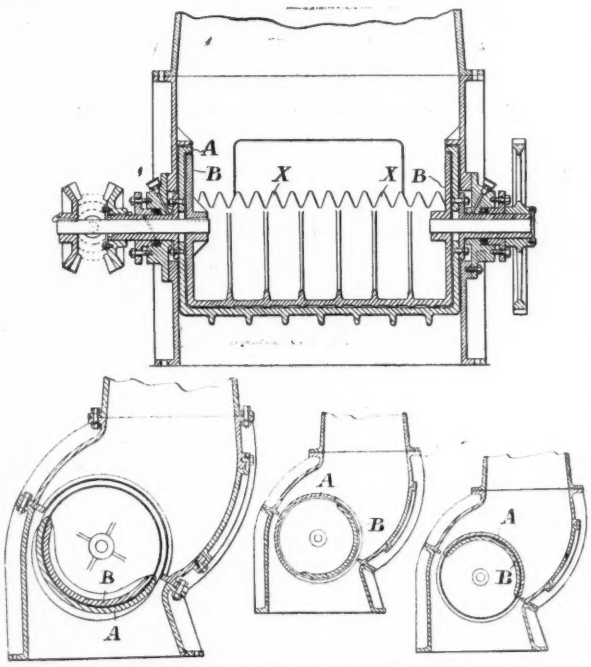
REGISTER OF PATENTS.

Discharging Vertical Retorts.

DRAKES LIMITED, and DOBSON, A., of Halifax.

No. 4105; Feb. 18, 1913.

This mechanism is of such a character as will enable the discharging of any desired quantity of coke without the possibility of any larger quantity being permitted to descend by gravity. A further advantage secured by the mechanism is that "the coke extracted is not broken to the extent that is necessary for its discharge by devices at present in use."



Drake and Dobson's Vertical Retort Discharger.

A longitudinal sectional elevation of the apparatus is given; also a cross-sectional elevation of certain parts.

In connection with each retort, a pair of semi-cylindrical drums A B are arranged so that their axes are co-incident; the drum B being so much less in diameter and length than A, that it will take-into and operate within it, and rotate in one direction while the drum B is rotated in the other direction. As these pairs of drums are being rotated, they will at one time present their open sides to the base of the retort, so that the material within it will, by gravity, descend and enter the drum B. By continuing the motions of the drums from the position shown, their opposite edges will commence to approach each other gradually, cutting their way through the material which now extends from the interior of the drums up into the retort above. These rotary motions being still continued after the edges of the drums have met, the portion of the material within is cut off from that above, and by the drums still moving forward their open sides are gradually brought face downwards to deposit their contents into the space below.

In order that the cutting edges may perform their functions by shearing actions, the prongs X may be of varying lengths; the longer prongs being made to extend beyond the edges of the drums, but having their inner surfaces flat, so that the distance between the points of the prongs on opposite sides of the drum exactly equals, or is larger than, the inner diameter of the drum. The longest prongs may be about midway the length of the two drums; the remaining prongs gradually diminishing in length towards the right and left, where are the shorter prongs, or the longest prongs may be at one end of the drums; the remaining prongs gradually diminishing in length towards the other end.

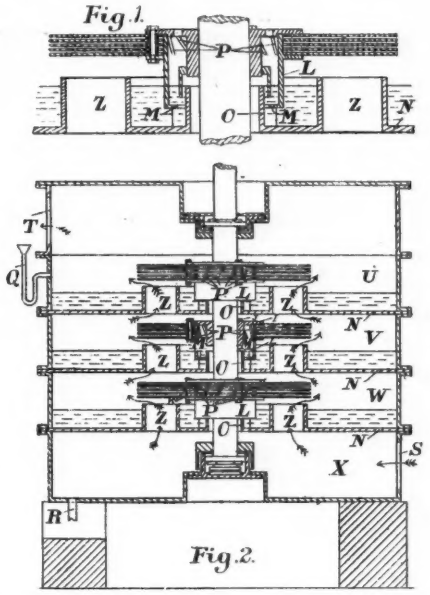
Treating Gases by Spraying Apparatus.

FOWLER, C. H., and MEDLEY, E. A., of Liverpool.

No. 10,963; May 9, 1913.

This invention relates to apparatus for treating gases and vapours where liquid is fed upwards from an annular dish by axially rotating tubes on to the centre portion of spaced horizontal discs rapidly rotating upon a vertical axis, whereby the liquid is sprayed across the gas-passage provided between the peripheries of the discs and the casing.

In their patent No. 23,864 of 1911 the inventors described an apparatus with several groups of closely-spaced discs fixed on one shaft—the bottom disc of each group being imperforate, and the discs above having central openings within which helically arranged vanes are fixed to the shaft. The liquid, flowing along the radial channels, falls upon the vanes, which scatter it on to the discs: and these throw it across the annular gas-passage in a finely-divided spray. In such a machine, they point out, the liquid, after it has been sprayed once by the top group of discs, descends to the next group, which sprays it once and passes it down to the third group; and so on, until it flows away from the apparatus at the bottom. But for some purposes it is necessary that the liquid should be sprayed many times by each group of discs; and the object of the present invention is to achieve this re-spraying of the liquid in a simple and direct manner.



Fowler and Medley's Spray Apparatus for Gas Washers.

Fig. 1 shows, in vertical section, a group of discs with internal cylinder, and a portion of the annular dish from which the cylinder raises the liquid to the discs; and fig. 2, an apparatus with several groups of discs and internal cylinders constructed according to the invention.

Referring to fig. 2, centrally mounted in a cylindrical casing is a vertical shaft; and on it, at equal distances apart, are three groups of discs. The discs of each group are fixed to a flanged collar, and distance collars are inserted between the discs. The discs of each group are perforate round the shaft, and within the central opening so formed; and concentric with the shaft there is fixed to the flanged collar, by bolts, a cylinder L. The upper parts of the walls of the cylinders, where they are surrounded by the discs, are pierced by a number of inclined slots P, and the lower portions are prolonged below the groups of discs, so that the bottoms, which are furnished with internal lips M, dip into annular dishes formed by dividing plates N with tubular centres O and the outer casing of the apparatus. The plates N are furnished with tubular gas-passages Z, through which the gas travels as shown by the arrows.

The liquid to be sprayed is fed into the apparatus by the trapped sump Q, and leaves it by the pipe R, which is also trapped.

The inlet orifice for the gas is at S and the outlet at T; the gas flowing upwards through the machine, as indicated by the arrows.

When the apparatus is in action, the liquid for treating the gas is fed into Q, and fills the chamber U up to the height of the central tube O, overflowing which it passes into the next lower chamber V, after filling that into the chamber W, thence into the chamber X, and out by the pipe R. The level of the liquid in each chamber is thus fixed by the height of the central overflow tubes.

The shaft being rotated at a sufficiently high speed, the liquid rises inside the cylinders L until it reaches the inclined slots P, through which it is flung on to the discs, and from the peripheries of these it is flung off in the form of finely-divided spray. The slots are inclined to ensure that the liquid is evenly distributed among the several discs of a group—reaching the upper ones equally with the lower.

After leaving the peripheries of a group of discs, the spray passes across the annular space between the peripheries and the casing of the apparatus, and, falling back into the bottom of the chamber, is again drawn up by the revolving cylinder and sprayed by the discs. Thus, once the chambers are full to the level of their overflows, a fixed quantity of spray will continue to leave the peripheries of each group of discs independent of the amount of fresh liquid that may be entering at Q.

Heating Vertical Retorts.

DUCKHAM, A. M'D., of Ashtead, Surrey.

No. 12,338; May 27, 1913.

As a means of utilizing some of the sensible heat in the coke which leaves a continuously operated vertical retort, the patentee remarks that it has been proposed to pass the primary air, or secondary air, or both, around the lower part of the retort and thus to convey some of the heat in the coke travelling through that part to the producer or to the flues that heat the retort, or to both producer and flues. Although this arrangement extracts some of the heat from the coke, it does not raise the temperature of the air sufficiently; and it is still necessary to provide separate recuperators "if the best results are desired."

The present invention is said to avoid this additional construction by causing the waste gases from the heating flues of the retort to pass through flues in contact with those through which the primary or secondary air or both, or cool producer gas, pass around the lower part of the retort. In this manner, the air or gas to be heated may be, as it were, sandwiched between the hot retort and the waste-gas flues. The invention is particularly applicable to the system of downward

heating of the retort, since the heating flues can be continued downwards to constitute the waste-gas flues surrounding or in contact with the air-heating flues.

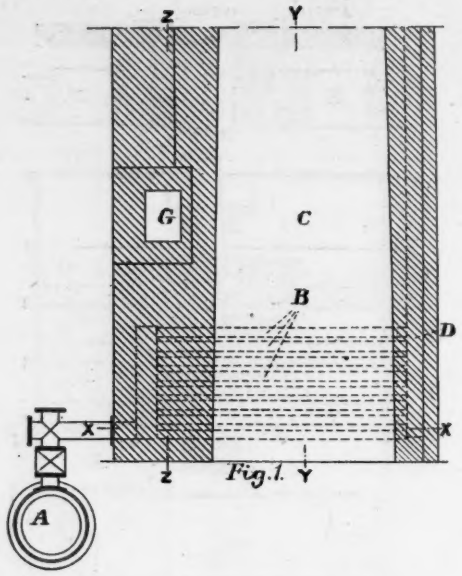


Fig. 1.

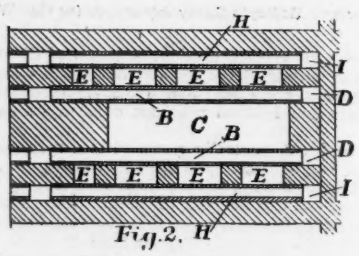


Fig. 2.

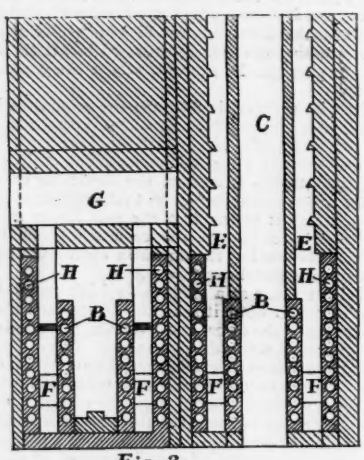


Fig. 3.

Duckham's Heater for Vertical Retorts.

Fig. 1 is a longitudinal vertical section through the lower part of a retort to which the invention is applied. Fig. 2 is a horizontal section on the line X of fig. 1. Fig. 3 is a vertical section on the line Y of fig. 1 as to its right-hand half, and on the line Z as to its left-hand half.

In this example the retort is heated by substantially cold producer gas supplied through a main A. The gas is drawn by the draught through flues B in the side walls of the retort C, at the part of it which is occupied by the hot coke before it leaves the retort. The gas thus heated passes up the flues D to the upper part of the heating flues E, where it meets the secondary air. The heating flues are continued downwards as waste-gas flues past the flues B; the waste gases escaping through flues F to the main chimney flue G. The secondary air is drawn through the flues H in the sides of the extensions of the heating flues, and passes up the flues I to meet the gas in the upper part of the heating flues.

When the producer is in close proximity to the retort-setting so that the gas does not lose its sensible heat before it is burnt, the flues B may serve to heat the primary air; or, if this is not required, they may be used, together with the flues H, to heat the secondary air. On the other hand, the flues H may be omitted and the flues B be used alone for the secondary air.

Ammonium Sulphate Manufacture.

JOHNSON, J. Y.; a communication from the Badische Anilin und Soda Fabrik, of Ludwigshafen-on-Rhine, Germany.

No. 12,979; June 4, 1913.

In their specification, the patentees remark: The oxidation of ammonium sulphite in solution by means of oxygen or air has often been attempted; but it proceeds so slowly that it has hitherto been preferred to obtain the salt in the solid state and then oxidize it in order to convert it into ammonium sulphate—see Burkheiser's patent No. 12,227 of 1911. Addie, in his patent No. 3246 of 1883, described the treatment of gas containing ammonia with sufficient sulphurous acid gas to fix the ammonia, dissolving the sulphite formed in a scrubber, and oxidizing the solution of ammonium sulphite by forcing air into it, in which process hydrated oxide of manganese, or similar oxygen-carrying agents, may be added to the solution. Collett and Eckardt, in their patent No. 16,629 of 1911, described the production of a neutral sulphite of ammonia, and oxidizing this with oxygen or air, and continuously adding further ammonia to combine with the sulphur dioxide liberated.

The Badische Company state that they have now found that the oxidation of ammonium sulphite in the form of solution can be carried out easily and rapidly by treating the solution with oxygen—*e.g.*, with practically pure oxygen, or air in the presence of a solid porous body which is capable of acting as an oxygen carrier, while maintaining the solution alkaline with ammonia. As examples of suitable oxygen carriers they mention charcoal, fire-clay, pumice, ferric oxide, and manganese dioxide. Mixtures can also be employed—for instance, the porous oxygen carrier may contain platinum, manganese compounds, iron compounds, or cerium compounds. And it is possible, according to the present invention, to employ in the solid porous state oxygen carriers or catalysts even if they are soluble in acid.

The oxidation here referred to is preferably carried out at a raised temperature, and, if desired, the production of the solution and its oxidation can be carried out in the same apparatus. The ammonium sulphite solution can also contain some solid ammonium sulphite, which latter during the oxidation gradually goes into solution and then becomes oxidized.

A simple method of maintaining the solution alkaline is repeatedly or continually to add ammonia; and the process according to the present invention readily permits of the production of saturated or even of supersaturated solutions of ammonium sulphate, from which the solid sulphate then separates out in a pure state.

It is often advantageous to carry out the process according to the present invention under increased pressure, since the reaction then proceeds even more readily, and complete oxidation can be obtained in a very short time when using oxygen or even air as the oxidizing agent.

The following example serves to illustrate further how the invention may be carried out in practice: Place concentrated ammonium sulphite solution containing a small excess of ammonia in an "autoclave" containing pieces of porous clay coated with manganese hydroxide, and then, while maintaining a temperature of or about 80° C. and a pressure of about 20 atmospheres, pass a current of air through the solution. It is preferred to add a little ammonia to the air in order to replace the small quantities of ammonia which pass away with the gases from the autoclave, and which can be readily recovered in any suitable manner.

Gas Analysis Apparatus.

TAPLAY, J. G., of Streatham Hill, S.W., and ABADY, J., of Fountain Court, E.C.

No. 17,676; Aug. 1, 1913.

This invention relates to apparatus for the analysis of gases and vapours, and deals more particularly with the means of conducting the combustion process. It may be of interest to reproduce the specification practically *in extenso*.

The methods by which the combustible constituents of gas or vapour—such as the vapour of liquid hydrocarbons—are usually determined may be divided into three classes: Firstly, by explosion with air or oxygen; secondly, by mixing with an excess of air or oxygen and leading the mixture over a heated platinum wire or the like; and, thirdly, by combustion over copper oxide in a suitable form. The combustion over heated copper oxide has the characteristic compared with the other two methods that it does not require the introduction with the gas or vapour to be analyzed of any air or oxygen. Owing to the fact, however, that the oxide is used in a granulated or wire form in a tube, there is a mechanical difficulty (or inconvenience) in making an analysis, because it is necessary to introduce an inert gas—such as carbon dioxide or nitrogen—in order to sweep-out the products of combustion and the residual gas which remains after the gas being analyzed has been passed over the copper oxide tube for combustion, part of which would otherwise remain behind in the tube owing to pockets of gas being formed among the copper oxide.

The present invention relates to apparatus for analysis in which combustion is effected over heated copper oxide. The known methods of combustion over heated copper oxide may be divided into three classes: (*a*) That in which the combustion-tube enclosing the copper oxide, both before and after the combustion is made, contains a volume of nitrogen purposely admitted; (*b*) that in which the combustion-tube enclosing the copper oxide is filled with carbon dioxide from a generator—a further quantity of this gas being employed after the combustion to sweep out all nitrogen residue from the combustion-tube and connections, so that, after the absorption of the carbon dioxide by means of a solution of potassium hydroxide, a direct measurement of the nitrogen residue may be made; (*c*) that in which the combustion-tube enclosing the copper oxide is filled with nitrogen from a reservoir—a further quantity of this gas being employed after the combustion to sweep out all the carbon dioxide formed during the combustion of a hydrocarbon gas or other carbon dioxide producing gas. The carbon dioxide, after absorption by a solution of potassium hydroxide, owing

to loss of volume, gives a measure of the hydrocarbon gas or other carbon dioxide producing gas under analysis; any nitrogen residue being estimated by difference.

In each of these methods there is an objection to estimating the residue as the difference between the sum of all the other constituents of a gas mixture and the total quantity of gas taken for analysis, as such a method gives no guarantee that the volumes of the other constituents are correct. Therefore any error will fall on the residual gas.

In the present invention, the gas to be analyzed is passed through a tube of fused silica enclosing copper oxide in such a form that, after the combustion, the products of combustion and the residual nitrogen can be entirely removed from the combustion-tube by means of either mercury or other displacing liquid, but preferably by means of mercury —thereby making it possible to determine by direct measurement the volumes of carbon dioxide produced from the oxidized hydrocarbon or carbon monoxide, as the case may be, and of any residual nitrogen. This could not be done conveniently when employing the copper oxide in the granulated form, or in the wire form, because the displacing liquid would not wholly displace the gas after combustion—"pockets" of the gas would remain behind in the copper oxide. It would also be difficult to remove all the displacing liquid when necessary.

The copper oxide is used in the form either of a rod or tube of any convenient length and cross-section. It being difficult to manufacture a rod or tube of pure copper oxide of the requisite dimensions, the copper oxide (preferably in the form of cupric oxide) is mixed in any proportion with a matrix of calcium sulphate or fire-clay, or china clay, or magnesia, or any other material which will have the property of "binding" the copper oxide together, but without rendering the mixture vitreous when exposed to a bright-red heat, and at the same time will resist disintegration of the mass when subjected to changes of temperature. The rods may also be obtained by immersing sticks of fire-clay, calcium sulphate, china clay (kaolin), or magnesia in solutions of the salts of copper—such as the nitrate or sulphate. The rods so treated are then dried and finally oxidized at a red heat in a current of air or oxygen. In this manner the sticks are impregnated with copper oxide.

The patentees find that the best results are obtained by mixing two parts by weight of finely-ground black oxide of copper with one part by weight of powdered china clay (kaolin). The black copper oxide best suited for the purpose is that known as "wire form," although other forms can be employed. The china clay employed acts as a matrix; and although kaolin is best suited for the purpose, other silicates of alumina may be employed.

The mixture of copper oxide and matrix is made into a paste with such an amount of water as will permit it to be rolled or moulded or pressed through an orifice to any desired shape and dimensions. The mixture is then slowly air-dried to remove the excess of water, and afterwards exposed to a bright red heat for such a length of time as will produce the condition known to potters as "biscuit." In this form the mass is porous to gases, but is not porous to mercury, and it will not disintegrate when exposed to changes of temperature.

If a rod of the mixture already described is to be employed in the form of a tube, the tube is enclosed within a tube of fused silica or of other suitable material. After fixing the rod of copper oxide and matrix (or the tube of copper oxide and matrix) within the combustion-tube, air or oxygen is passed over the rod or through the tube of copper oxide and matrix, as the case may be, to saturate the copper oxide with oxygen, in order to bring it to the state of cupric oxide (CuO).

If the copper oxide and matrix are in the form of a rod, the gas within the combustion-tube can be displaced by the confining liquid, which surrounds the rod. But if the copper oxide and matrix are employed in the form of a tube, the gas within the tube can be displaced by the confining liquid, which flows through the tube. In either case the whole of the gas can be displaced by the combustion-tube and conveyed to a measuring-burette and its volume observed.

In making an analysis of a gas mixture—such as coal gas, producer furnace gas, water gas, &c., a measured volume of the non-absorbable mixed constituents (hydrogen, methane, nitrogen) is passed through the tube enclosing the rod or tube of active material (copper oxide and matrix) maintained at a red heat, whereby the hydrogen is turned to water and the methane to water and carbon dioxide. The loss of volume gives a measure of the volume of hydrogen, and the volume of carbon dioxide produced gives a measure of the volume of methane present. The nitrogen residue remains unaltered. The rod or tube of copper oxide and matrix is of such dimensions as to ensure that there shall be an excess of cupric oxide over that required for the volume of gas taken for the combustion.

The reactions taking place in presence of an excess of cupric oxide, for the following gases, are:

(1) Hydrogen. . . $2(CuO) + 2(H) = Cu_2O + H_2O$
(2) Carbon monoxide $2(CuO) + CO = Cu_2O + CO_2$
(3) Methane . . . $8(CuO) + CH_4 = 4(Cu_2O) + CO_2 + 2(H_2O)$
(4) Benzene . . . $30(CuO) + C_6H_6 = 15(Cu_2O) + 6(CO_2) + 3(H_2O)$
(5) Ethylene . . . $12(CuO) + C_2H_4 = 6(Cu_2O) + 2(CO_2) + 2H_2O)$

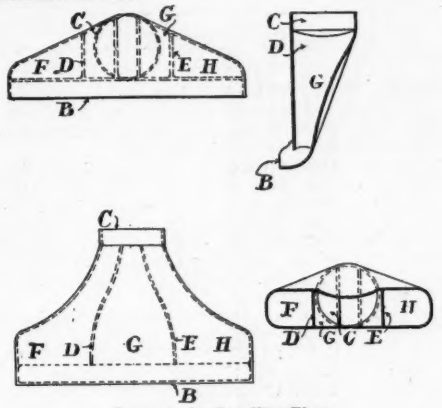
There is thus no reduction of the cupric oxide to the metallic state; and when mercury is used as the displacing liquid no amalgamation can take place.

Gas-Fires.

CARPENTER, C. C., of Old Kent Road, S.E.

No. 3159; Feb. 6, 1914.

In gas-fires it is usual to employ (the patentee remarks) a cast-iron canopy or hood, for collecting the products of combustion, having an elongated or oval-shaped flue leading from it, for the purpose of providing an outlet for the gaseous products into the chimney. The patentee proposes to "so form the box for collecting the combustion products that the latter are drawn evenly over the whole width of the backing, and are conducted towards the outlet or flue without creating any objectionable eddies."



Carpenter's Gas-Fire Flue.

A front elevation of a box for combustion products embodying the improvements is shown; also a plan view, and two sections.

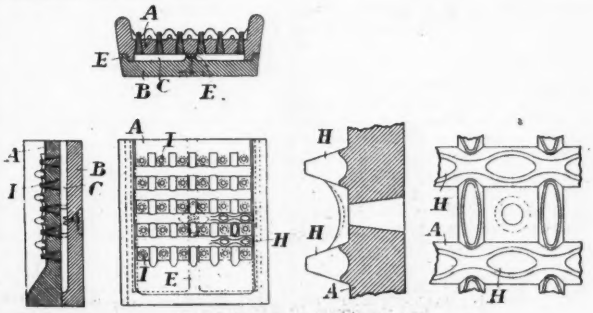
The box (preferably of metal) has its front extended the whole width of the fire, and is furnished with an inlet B. The width of the box is gradually diminished and its depth somewhat increased from front to back, where is arranged a circular hole C to be connected to the flue. Within the box are walls D E dividing it into three passages F, G, H —all leading to the flue hole. The side passages F and H are of equal capacity, and each is of a slightly greater capacity than the central passage G. In this way, the flue area is in proportion to the work to be done over the whole width of the fire. "The effect of this is that the products of combustion which have a normal tendency towards the middle are more evenly distributed, and there is little likelihood of eddies being set up in the box, which is constructed in a form to lead away the products in a natural way—the box being without corners or recesses likely to create pockets and to give rise to the eddies referred to."

Backings for Gas-Fires.

CARPENTER, C. C., of Old Kent Road, S.E.

No. 3160; Feb. 6, 1914.

The object of this invention is to provide a backing for gas-fires made of two comparatively thin pieces of fire-clay or similar material arranged in such a manner as to provide a space between them, which can be filled with slag-wool, asbestos, or other suitable material. The front wall has preferably projections on the surface exposed to the gas flames for the purpose of breaking-up the ascending products of combustion. The wall may also have holes through which pegs (preferably inserted from the back) may be fixed for supporting the "radiants" or other fuel.



Carpenter's Gas-Fire Backings.

The comparatively thin front plate or wall of the fire A and a back plate or wall B of fire-clay are so arranged that between them there is a space C, to contain slag wool or other non-conducting material. A backing of considerable thickness is thus provided. The width of the space between the plates is determined by webs E or other separating device. The plates may be attached by means of a bolt and nut, and then fitted to the gas-fire exactly like a solid backing; or the back plate may be mounted on the iron plate of the fire-place and the front plate (fixed to the gas-fire) set in front of it and the slag wool packing introduced between.

The projections B applied to the front of the plate will preferably take the form of those shown. I are tapered pegs of fire-clay inserted through holes in the plate A from the back for supporting the radiants (not shown).

APPLICATIONS FOR LETTERS PATENT.

13,527.—EHRICH & GRAETZ, "Cerium-iron lighters." June 3.
13,586.—WATLING, A. E., "Gas-meters." June 4.
13,643.—FABRY, R., "Reducing sulphur contents of metallurgical coke." June 5.
13,693.—STOTT, V. H., and SCHOFIELD, L., "Water-heaters." June 5.
13,694.—EWART, S., "Gas-coppers." June 5.
13,704.—ROUBZOFF, G., "Production of gas." June 5.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF COMMONS.

The following further progress was made with Private Bills:—

The Bristol Water Bill was read a second time and committed.

The Ossett Corporation Bill and Gas and Water Provisional Orders (No. 1) Bill were reported with amendments.

The Dundee Boundaries Extension and Gas Order Confirmation Bill, Cleckheaton Urban District Council Bill, Local Government Provisional Orders (Nos. 12 and 13) Bills, and Local Government Provisional Orders (Gas) Bill were read the third time and passed.

The Gas Provisional Orders (No. 3) Bill, relating to Swansea, has been referred to a Select Committee consisting of Mr. Hugh Law (Chairman), Mr. Hambro, Mr. Sherwell, and Captain Leslie Wilson; to meet to-morrow (Wednesday).

The following petitions have been presented against Private Bills: Lurgan Gaslight and Chemical Company against Electric Light Provisional Orders (No. 5) Bill; East Ham Corporation against the Gas Light and Coke Company Bill; Alkali Manufacturers' Association against the Gas Provisional Orders (No. 3) Bill.

Lanarkshire Gas Order Confirmation Bill.

This Bill, "to confirm a Provisional Order under The Private Legislation Procedure (Scotland) Act, 1899, relating to Lanarkshire Gas," was presented in the Lower House by Mr. M'Kinnon Wood, and read the first time.

BRENTFORD GAS BILL.

A QUESTION OF LOCUS STANDI.

COURT OF REFEREES.—Thursday, June 11.

(*Before Mr.* MOONEY, *Chairman, Mr.* E. MOON, *K.C., Speaker's Counsel, Sir* PHIPSON BEALE, *K.C., Mr.* WHITE, *Mr.* STAVELEY HILL, *and Mr.* ROBERTS.)

In this case the Metropolitan Electric Supply Company applied for *locus* against the Bill promoted by the Brentford Gas Company.

Mr. ARTHUR MOON appeared for the Brentford Gas Company; and Mr. BALFOUR BROWNE, K.C., represented the Metropolitan Electric Supply Company.

Mr. BALFOUR BROWNE said he asked for *locus* against Part IX. of the Bill, which gives the Brentford Gas Company certain powers in regard to electricity supply. Up to the present the Company had been a gas company pure and simple, and were supplying gas in the large area over which the Metropolitan Electric Supply Company had electricity powers. By clause 64 of the Bill the Gas Company took power to apply to the Board of Trade for Electric Lighting Orders for districts where there did not exist an electric lighting authority; and under clause 65 they asked power to take transfers of existing Orders. If the clauses were passed, the Gas Company would have identical powers in the Metropolitan Company's area which the Metropolitan Company themselves had had conferred upon them by Parliament; and thus there would be competition set up between the two Companies. The Gas Company's Bill was opposed in the other House by the Electric Supply Company, and *locus* was not objected to. The Metropolitan Company had a large area in which they could supply electricity under Acts granted in 1905 and 1906.

Mr. E. MOON: You can only supply in bulk.

Mr. BALFOUR BROWNE said that was so; but the Company also had power to take over Electric Lighting Orders, and, indeed, had already done so in a number of cases. Furthermore, under the Act of 1905, the Supply Company could apply for Electric Lighting Orders.

Sir PHIPSON BEALE pointed out that this was only a permissive right to apply, and the proposal of the Gas Company did not do any more than could be done by extending the objects in the Articles of Association of a Joint-Stock Company.

Mr. E. MOON: You are a bulk supply company. There is nothing in Part IX. which authorizes the Gas Company to supply in bulk.

Mr. BALFOUR BROWNE replied that the Electric Supply Company had the power to take over the supply in detail from authorized distributors; and clause 65 of the Bill was identical with clause 12 of the Metropolitan Electric Supply Company's Act of 1906.

Mr. E. MOON said that the competition alleged by Mr. Balfour Browne under this section of the Bill was not the competition for the supply of electricity, but competition in bidding for, or taking over, an existing Order.

Mr. BALFOUR BROWNE said it was competition in a sense for customers, and that was all-important to him.

Sir PHIPSON BEALE: Supposing any other company asked for the right merely to apply for an Electric Lighting Order, would the Electric Supply Company have *locus?*

Mr. BALFOUR BROWNE said he thought it would, because it was one step towards competition.

Sir PHIPSON BEALE said that if a joint-stock company was formed with the object of supplying electricity in certain districts, the Supply Company would not have *locus* till the actual Order was applied for.

The CHAIRMAN: I understand you are coming here on the ground of competition? Clause 64 does not set up any competition with your Company; and it appears to me at first sight that your title to *locus* on competition would be if and when this Company applied for a Provisional Order.

Mr. BALFOUR BROWNE asked the Court to remember that at the present time the Gas Company had not even got the power to apply for an Electric Lighting Order, and that by inserting this clause in the Bill they were taking one step in the direction of competition. On this ground, he claimed he was entitled to *locus*.

The CHAIRMAN: But it is not an application to compete with you. It is merely power to apply to the Board of Trade to give competitive powers.

Mr. BALFOUR BROWNE said that nevertheless it put the Gas Company in a position it was not in to-day. Although it was not the final step towards competition, it took them one step nearer to it. Under clause 65 the Gas Company would have exactly the same powers to take over Electric Lighting Orders as the Electric Supply Company had been given by Parliament, and would be able to compete for the taking over of existing Orders. As a matter of fact, the Electric Supply Company had already taken over five or six, and were looking forward to taking over more. The Gas Company would, under the clause, be in a position to compete with the Electric Supply Company for taking over these Orders. He agreed that a company specially formed to take over any one particular Order would have to be fought by him. He also drew attention to the Board of Trade report to the House of Lords Committee who considered the Bill, in which it was stated that in the view of the Board it was inexpedient that a gas company should be entrusted with electric lighting powers.

Mr. ARTHUR MOON, on behalf of the Brentford Gas Company, pointed out that five local authorities were opposing the Bill, and would bring this matter before the Committee.

Mr. BALFOUR BROWNE once more argued that competition was being set up with the Company he represented, and that therefore he was entitled to *locus*.

Mr. ARTHUR MOON objected to *locus* on the ground that there was no competition within the meaning of the Standing Order, and, further, on the ground that the Court had already decided an exactly similar case—indeed, there were two cases in which the very point had been decided. The first was the Yorktown and Blackwater Gas Act, which gave the Company power to supply electricity within their area of supply. The local authority were at the moment applying for an Electric Lighting Provisional Order, and asked for *locus* against the Bill; but the Court decided that there was no competition. That case, he contended, was even stronger than the present one, because under the Brentford Bill the Gas Company were not actually asking for electric lighting powers, but merely the right to apply for them. The other case was that of the transfer of the Wood Green Electric Lighting Order to the Tottenham and Edmonton Gas Company. Wood Green was in the area of supply of the North Metropolitan Electric Power Supply Company, who applied for *locus* on the ground of competition. It was, however, proved before the Court that the Power Company were not supplying; and the Court refused to grant *locus*.

Mr. E. MOON said he did not remember a case of *locus* on competition, except for competition in carrying out the purposes for which the Act was promoted. In this case it was a sort of competition possibly, because a further class of person was asking to be entitled to carry on the particular business.

The Court eventually disallowed the *locus* applied for.

OSSETT CORPORATION BILL.

HOUSE OF COMMONS LOCAL LEGISLATION COMMITTEE (SECTION A).

Tuesday, June 9.

Part IV. of this "Omnibus" Bill deals with the gas undertaking of the Ossett Corporation. The proceedings before the Committee in relation to the opposition by the Horbury Urban District Council as to a testing-place in Horbury were reported in the "JOURNAL" for April 28 (p. 269). The decision was to the effect that so long as the present conditions of the supply of gas of the same quality to Ossett and Horbury continue, the Horbury Council should not have a separate testing-station. A clause giving effect to this decision was to-day brought up before the Committee, and passed in the following terms as an addition to clause 46, which deals with the calorific value:

> (1) If and whenever the Corporation shall so alter their gas-works as to enable them to supply gas to consumers in the urban district of Horbury from and by means of a separate gasholder, from and by means of which the gas shall not also at the same time be supplied to consumers within the borough, the Horbury Urban District Council, at their own expense, may provide and maintain a testing-place within the said urban district, and may therein provide and maintain apparatus for testing the calorific value of the gas mentioned in this section; and such testing-place shall be a prescribed testing-place within the meaning and for the purposes of the provisions of this section.
>
> (2) No test shall be made at such last-mentioned prescribed testing-place except by a gas examiner appointed by the said Urban District Council, or by the Justices on the application of consumers of gas within the district.
>
> (3) Before an official test is made at such last-mentioned testing-place, reasonable notice of not less than two hours shall be given to the Corporation of the time at which it is proposed to make such test, so as to enable them to be represented by some officer, who shall not interfere with the test.

It is made clear in the Bill that the testing apparatus is to ascertain the total heat value of the gas.

Mr. JEEVES explained to the Committee that this was an agreed clause with the Horbury District Council; and he pointed out that there were certain other amendments in clause 46, which dealt with the calorific power test.

In the earlier proceedings the final wording of the clause was left over, pending the decision in the Gas Light and Coke Company's Bill. The necessary amendments have now been embodied in the Bill. Originally the Corporation asked for a maximum figure of 520. This has now been fixed at 540, and the variation is 7½ per cent. below 540, as in the Gas Light and Coke Bill. The rest of the clause is the same as that of the Gas Light and Coke Company, with the exception of the penalties. In the Bill as originally drafted, these were 10s., £1, and £2; but the penalties imposed in the Morley Bill, to which reference

was made in our last report, have been inserted in the present Bill—namely, £2, £5, and £10.

The Committee then went through the remaining clauses in the gas section of the Bill, which were unopposed, except, of course, as regards any comments made by the Local Government Board or the Home Office.

Clause 40 (Power to Purchase Lands by Agreement) and clause 41 (Power to Sell Lands) were added to the Bill.

Clause 42 (Dwelling Houses for Employees) was the subject of a comment by the Local Government Board, who suggested that the use of the dwellings should be limited to employees of the gas undertaking, and also that the dwellings should be erected upon land belonging to the gas undertaking.

The necessary amendments having been made, the clause was ordered to stand part of the Bill.

Clause 43 (Power to Lay Mains beyond Limits of Supply) gives the Corporation all the powers of a gas authority along so much of the Wakefield to Dewsbury main road within the borough of Dewsbury adjacent to the Ossett Corporation's boundary.

The CHAIRMAN (Mr. Middlebrook) asked what the position would be as regards the effect upon other authorities. For instance, would the Corporation give notice to the county authority when desiring to lay mains?

Mr. PARKER (Messrs. Sharpe, Pritchard, and Co, Parliamentary Agents) said that the Corporation would be subject to the Gas-Works Clauses Act. In this particular case the county authority was the county borough of Dewsbury, who were satisfied with the clause.

The clause was agreed to.

Clause 44 (Power to Lay Mains in Streets not Dedicated to Public Use), clause 45 (Power to Lay Pipes for Ancillary Purposes), and clause 45A (Protection for the Wakefield Rural District Council) were ordered to be added to the Bill.

The CHAIRMAN asked if there were any other precedents for clause 47 (Fittings not to be Liable to Distress) except Herne Bay.

Mr. PARKER said he believed there were a number of precedents; but whether the wording of this clause followed precisely the wording of the precedents, he was not sure.

The clause was passed.

Clause 48 (Power to Enter Premises and Remove Fittings) and clause 49 (As to Construction and Placing of Pipes between Mains and Meters) were both Model Clauses, and were passed.

Clause 50 deals with the use of anti-fluctuators; and it was explained that the word "efficient" has been added before the word "anti-fluctuators" in order to ensure the use of efficient apparatus. This was agreed to, as was also clause 51 (Power to Refuse to Supply Persons in Debt for Other Premises).

This concluded the consideration of the gas portion of the Bill.

LEGAL INTELLIGENCE.

LIGHTING AGREEMENT DISPUTE AT SWANSEA.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

Tuesday, June 9.

(*Before Mr. Justice* WARRINGTON.)

Swansea Gaslight Company v. Swansea Rural District Council.

The hearing of this action, the opening proceedings in which were reported in the "JOURNAL" for June 2 (p. 661), was resumed to-day.

Mr. GEORGE CAVE, K.C., and Mr. PERCY F. WHEELER appeared for the plaintiffs; Mr. CLAUSON, K.C., and Mr. TOMLIN, K.C., represented the defendants.

Mr. CLAUSON continued his argument on behalf of the defendants, contending that the agreement had been superseded by arrangement between the parties before the Parliamentary Committee, and that defendants were at liberty to put in force their powers for supplying electrical energy for lighting purposes within any portion of the district agreed to be lighted with gas by the plaintiffs. Having read the correspondence which had passed between the parties, he observed that the defendants had no intention of supplying electricity in any districts already supplied by gas; but it was impossible for a public body to bind themselves that they would not for 25 years exercise the powers conferred on them by Parliament. Clause 16 of the agreement of 1909 was clearly *ultra vires*, and could not be enforced against the defendants.

Evidence was then given in support of the defendants' case.

Mr. *A. J. Lees*, Parliamentary Agent, said he had advised the Council for many years past. He recollected the Provisional Order of 1910 being obtained by the Gas Company. There was a discussion in the lobby when the confirming Bill was before the House; the Board of Trade official suggesting that an agreement should be arrived at. When the parties came before the Committee, Mr. Pollock indicated that there was a possibility of a settlement, and there was an adjournment. As the result of discussion, a settlement was arrived at. The result of the combined conference was that the price of gas within a mile of the borough was to be the same as that within the borough, and that beyond the mile radius the Company were to be entitled to charge an extra 4d. The Council had all along contended that the Company should be put under obligation to lay mains outside the borough in the west; and they agreed to come under an obligation to do so. There was some discussion about Birchgrove, and it was arranged that if the Company went there within a year the Council would not go there with electric light. The arrangement so come to superseded the agreement, which from that day was treated as waste paper.

Wednesday, June 10.

Mr. *M. E. David*, a member of the Swansea Rural District Council, said he was Chairman of the Council for the year 1910-11—at the time of the meeting in London before the House of Lords Committee. He was present on July 5 and 6, 1910, when the Swansea Gas Company's Provisional Order came before the Committee. The Bill was opposed by the Council. He generally confirmed the evidence given by the previous witness as to the arrangement that was made.

Cross-examined by Mr. CAVE: The principal points insisted upon were price and compulsion on the Company to extend their mains to certain districts. He remembered Counsel reading out the terms of settlement. He could not account for the fact that the Counsel did not say anything about the withdrawal of the agreement of November, 1909.

Mr. CAVE: Do you say it was expressly arranged that the agreement should be at an end?

Witness: I do.

Who said so?—I cannot fix on any particular individual.

Will you say that any man said so in so many words?—It was put in that way generally; but I cannot fix on any person in particular.

You had it in your mind that the agreement was superseded?—Absolutely.

But you notice the terms of settlement do not include the withdrawal of the agreement?—It was discussed and arranged, and we withdrew our opposition on those lines. The Clerk afterwards reported that "the existing agreement would be superseded by the Order," and this is what we all had in our minds.

His LORDSHIP: You know that by the agreement of 1909 it was provided that the Gas Company should "undertake forthwith to extend their mains" to certain roads. Can you tell me whether, in July, 1910, the Company had fulfilled that provision?

Witness: I do not think they had.

Mr. *J. H. Rosser*, J.P., a member of the Council, said he was one of the deputation who came to town to represent the Council at the negotiations for a settlement. Witness said: "I suppose, according to this agreement, the old agreement will be void;" and Mr. Cooper objected in the strongest way. But eventually it was agreed that the old agreement should be dead and superseded by the new one.

Cross-examined: He could not explain why Counsel did not say that the old agreement was at an end. He was positive that Mr. Andrews and Mr. Glassbrook agreed that the new agreement was to supersede the old one.

Mr. *Edward Harris* said he had been Clerk to the District Council since 1901. When the agreement of 1909 was sealed, he was not aware it was proposed to apply for a Provisional Order. He attended the hearing before the Board of Trade on March 14, when Mr. Cooper contended that the agreement only fixed the price for the roads mentioned in Article I, and would not apply to mains extended under Article II. He confirmed the evidence already given as to the arrangement arrived at on July 6, and remarked that, as Counsel had said nothing about the old agreement being discarded, witness told him and Mr. Cooper that it must be mentioned; and they said it should be done next day. On the 6th a statement was made which satisfied him. Outside the committee-room, Mr. Andrews, then the Manager of the Gas Company, said to witness that, as the old agreement was discarded, it would be necessary to get a new one to provide for payment for gas supplied. Witness replied that he would like to consult Messrs. Lees, as he did not know to what extent the Provisional Order would govern them. It was also arranged that Mr. Andrews should consult Mr. Cooper. The first intimation that witness had of the Gas Company claiming that the old agreement still subsisted was when he wrote about the repair of a broken lamp.

Cross-examined: It did not occur to him that without parliamentary powers the Gas Company could not, even with the consent of the Council, supply gas outside their limits. The document read to the Committee did not refer to the cancellation of the agreement; but it was not a complete statement of the facts of the case. He agreed that if the writing was correct then there was no agreement come to for cancellation. He reported to the Council that terms of settlement had been come to as to price, extension of mains, and that if Birchgrove was not lighted with gas within a year the Council could light it with electricity. He certainly quarrelled with the minute, as it did not state that he reported to the Council that the agreement had been superseded by the arrangement arrived at.

This was the case for the defendants.

Mr. CAVE then called rebutting evidence.

Mr. *E. C. Cooper* said he was present at the Parliamentary Committee in July. It was not a term of the compromise that the agreement of 1909 was to be cancelled. He denied the statement made by Mr. Harris, that it was arranged the matter should be mentioned to the Committee the following day. His instructions were that under no circumstances was he to pledge the Company to extend to Birchgrove.

Cross-examined: He disagreed with the witnesses who had stated that there was considerable discussion as to the cancellation of the agreement being a term of the settlement. The statement before the Committee was not made by arrangement between witness and Mr. Lees. The words "agreement of compromise supersedes the agreement made in November" referred to the agreement embodied in the two clauses which constituted the compromise between the parties. The terms as stated by Mr. Vesey Knox on the 5th were erroneous so far as they contained a provision as to Birchgrove. This particular matter was discussed, but not agreed to. The terms stated by Mr. Knox to the Committee did not correctly represent those agreed to.

I suggest to you that the recollection of my witnesses is right and your recollection is wrong, when they say the question of the existence of the agreement of November, 1909, was discussed. You must be wrong in saying it was not discussed, because otherwise how did it get into Mr. Knox's statement or the clauses sent to Mr. Lees the same night?

Witness: I can only say my recollection is that I had clear instructions not to agree to the Birchgrove matters; the General Manager stating that they had given the Council quite enough.

Mr. *John Glassbrook*, a Director of the Gas Company, said he had a clear recollection of attending the Parliamentary Committee, but had no recollection of any arrangement that the agreement of November, 1909, should be cancelled.

Cross-examined: He was not prepared to contradict Mr. David and Mr. Rosser when they said the matter was discussed in the lobby.

Mr. *John Williams*, a Director of the Gas Company, said he was not in London in July; but he remembered the Manager at a meeting held on July 12 remarking that he considered the agreement of November was still subsisting; and the Chairman said that they met "without prejudice."

Thursday, June 11.

Mr. *George Thornton Andrews* said that until Dec. 31 he was Engineer, Manager, and Secretary of the Swansea Gas Company, and was now a Director. He had had prepared an Ordnance map showing where the mains were laid, and the boundaries of the different districts. In September, 1909, they were urged to extend their mains to Birchgrove and Lonlas. Knowing that these places were outside their limits of supply, he pointed out that they would have to go for a Parliamentary Order, and the deputation from the Council practically promised their support to the Order. Witness was present at the House of Commons on July 5 when terms were arranged between the Gas Company and the Council. The Council wished the Company to extend their mains to certain districts. He objected to Birchgrove and Lonlas, as they already had sufficient mains to lay. The terms proposed by the Council were that the Company should extend the mains to four places; and witness asked his Parliamentary Agent not to agree to Birchgrove and Lonlas, as the Company could not undertake so much mainlaying within twelve months, and these two places were struck out. It was not arranged that the agreement of 1909 should be cancelled. There was absolutely nothing mentioned in the House with reference to cancelling the agreement. The only mention of the agreement in London was when Mr. Harris was leaving the House on July 6 he said: "I think this will cancel your agreement," to which witness replied, "Does it really?" The Company continued to supply gas within the extended limits; and the Council paid the accounts quarterly. Apart from price, the Company continued to act under the agreement of 1909. The Council laid electric mains to Birchgrove and Lonlas in November. On July 12 a meeting between the representatives of the Company and the Council was held at the offices of the Council; and in the course of discussion it was contended for the Company that the agreement of 1909 was still valid, and as to Birchgrove and Lonlas, the Chairman (Mr. Rosser) said that this matter was closed, as they had already laid their mains. Witness said he could only discuss the matter on the ground that the agreement of 1909 was subsisting; and the Chairman said it could be done "without prejudice." He produced in Court his pencil notes of what took place at the meeting.

Cross-examined: On the suggestion of Mr. Harris, the minutes of evidence were referred to on the question of the cancellation of the agreement; Mr. Harris holding that they justified the Council's contention that the agreement was cancelled. Mr. Harris mentioned that they had taken Counsel's opinion with regard to the cancellation of the agreement.

When Mr. Vesey Knox made the statement as to Birchgrove, had the parties agreed, or not agreed, that if the Company did not extend their mains within one year from the confirmation of the Order the Council should be at liberty to put in force their electric powers?

Witness: They were agreed.

What occurred afterwards which made any alteration as regards the agreed term?—I objected to Mr. Cooper.

The Judgment.

Counsel having summed up

His Lordship delivered judgment. He said the case had given him a great deal of trouble, and he was not ashamed to say his opinion had altered from time to time in the progress of it. Plaintiffs asserted, and defendants denied, that an agreement made between the two with reference to the lighting of a certain part of the district was still binding. Plaintiffs further asked for an injunction to restrain the breach by defendants of a certain clause in the agreement the effect of which was to prevent the Council from setting up in certain places electric lighting in competition with gas lighting. Defendants alleged that the agreement was *ultra vires* and not binding on the parties. The facts were these: Under the Act of 1861, plaintiffs had the power of supplying gas within certain limits; and in 1908 the Council obtained a Provisional Order authorizing them to light Llansamlett with electric light. The Council desired to have certain portions of their district, not already lighted by gas, lighted by electricity. The Company being willing on certain terms to provide for the lighting of these districts, the agreement in question was made; and he was satisfied that at the date when the agreement became effectual—viz., at or shortly after Nov. 5, 1909—the Council knew that the Company intended to apply for further parliamentary power extending its district so as to render it possible legally to carry into effect the agreement. The agreement began by reciting that the Council were desirous of making provision for the lighting of the highways and streets within the parishes of Llansamlet and Chase Rural, and that the Company were willing to supply the gas; and it was agreed: (1) That the Company would forthwith extend their mains to certain specified roads; and (2) that the Gas Company should not be called upon to extend their mains to any road, street, or place beyond those mentioned in Article 1 unless certain conditions were fulfilled, and that upon these conditions being fulfilled the Company would, with all reasonable despatch, proceed to make the extensions. The result of this clause was that, although it began with the negative, subject to the fulfilment of certain conditions, the Company would make the further extensions. The agreement contained a number of stipulations with regard to price; and Article 16 provided that the Council agreed they would not, during the continuance of the agreement, put in force the powers conferred upon them by the Llansamlet Electric Lighting Order, 1908, so far as the supply of electrical energy for street lighting, private consumers, or other lighting purposes within the portion of their district agreed to be lighted with gas under the provisions of this agreement was concerned; and also that they would not, during the said period, substitute any other modes of lighting for gas in the district served by the Company. But nothing in the agreement should operate to prevent the Council at any time putting into force the Order for power purposes. Now what were the rights and obligations of the parties at the time the agreement became operative? It was contended on the part of the Council that the agreement was *ultra vires* because it provided for the extension of mains to places which, at the time the agreement was made, were outside the district. Did this render the agreement *ultra vires* the Gas Company? In his opinion it did not. At the time the agreement became operative it was common ground that, in order that it might be carried into effect, the Gas Company would apply for, and seek to obtain, a Provisional Order bringing within their district the necessary extended limits. In these circumstances, he was entitled to say the agreement was not *ultra vires*—that it was made effectual by the obtaining, as the Company did obtain, of the Provisional Order. The agreement as originally made was therefore binding on both parties. But this did not exhaust the question which had to be determined, as the Council said clause 16 was not binding on them; and in this he thought they were right. Section 11 of the Electric Lighting Act, 1882, provided that any local authority which had obtained a licence for the supply of electricity might contract with any person for the execution and maintenance of such supply; but no local authority, company, or person should by any contract assign or transfer to any other company, or divest themselves of any legal powers given to them, or any legal liability imposed by the Act, without the consent of the Board of Trade. It was contended on the part of the Council that the effect of clause 16 was to divest them of the power given them by the Provisional Order of lighting certain streets in their district. Unquestionably this was the effect of clause 16. Was it, within the meaning of the section, to "divest them of those powers"? The contention on the part of the Gas Company was that one must read the section as a whole, and when the Act prohibited a body from divesting itself of any legal power, it meant "divest" by transferring to another person. He was of opinion that the section did prevent a local authority from divesting themselves of any of their legal powers. It was immaterial whether the divesting was within a certain part of their district, and only for a certain period, and not for all time. That such a stipulation should be made was not altogether unreasonable, as the effect of an agreement by a public authority not to exercise the powers would mean that whatever might be the circumstances of the district which they governed they would be prevented from putting their powers in force, although it might be essential to the inhabitants of the district that they should put it in force. He therefore thought clause 16 was inoperative, and was not binding on the Council. This being so, it was immaterial to consider what was its true construction, though he was clearly of opinion that, according to the true construction of the clause, the restriction was limited first to the district which would be lighted from the mains referred to in Article 1, and to such district, if any, as might be brought within Article 2 by the fulfilment of the conditions of Article 2. The agreement was a valid agreement as a whole; but Article 16 was invalid and was not binding on the Council. The position might be this, that the Gas Company would be entitled to say the provision preventing competing is so essential to the whole of the agreement that they declined to be bound by any part of it. But they did not take up this position, being content to rest on the agreement with the excision of the clause. The next question was one which had given him some trouble. Defendants said, granted the agreement was valid and binding, it had, by mutual consent, been superseded and put an end to by a further agreement made on the occasion of the promotion of the Provisional Order extending the district. The Council had been insisting on the price of the gas, and that it should be made compulsory on the Company to extend their mains in various directions; and after some discussion between the parties, Mr. Vesey Knox read out terms which had been arranged on which the opposition would be withdrawn. This statement was made in the presence of the parties representing the Gas Company. In pursuance of this arrangement, certain new clauses were drafted, called 6 and 6A. The first dealt with the question of price, and 6A provided that if the Company did not extend their mains to Birchgrove within a year the Council should be at liberty to put in force their electric lighting powers. This clause carried into effect the terms read out by Mr. Vesey Knox. Ultimately, however, it was suggested that the provision as to Birchgrove had better be left out—that it would be inappropriate to insert such a provision in the Provisional Order, and that it would be enough if the Council gave an undertaking not to put in force their electric lighting powers if the Gas Company carried to Birchgrove within a year. It was remarkable that as the terms were drafted in the committee-room they were to the effect that if the Company should not extend their mains within the limited time the Council should be at liberty to put in force their powers. But when the actual terms of the new clause came to be settled, it was turned the other way; and the Council undertook not to put their powers into force for a year. The first form seemed to assume that Article 16 was in force, and the second form that it was not in force. On the following day, when the clauses were brought up, Mr. Cooper said they were the result of an agreement come to in reference to the terms of the Order, which agreement was a compromise, and superseded the agreement of November, 1909. The Clerk to the Council reported that the existing agreement would now be superseded by the Order, and that it was necessary to have a new agreement as to public lighting prepared. On July 15, 1910, Mr. Andrews reported to the Gas Company that the agreement come to with regard to the new clauses was a compromise, and superseded the agreement of November, 1909. Unfortunately there had arisen a conflict of recollection between the two parties as to what actually took place on July 5. On the one hand, it was said there was in terms an agreement that the whole agreement should be rescinded; while, on the other hand, it was said there was no such agreement made—that the question of the rescission of the agreement was never even discussed between them. If it were material to determine this question, he had come to the conclusion that plaintiffs were right, having regard to the correspondence. But this did not conclude the question. It was quite possible, though there was no such discussion or express agreement, that the actual agreement arrived at might have been arrived at on the footing that the agreement of November, 1909, was not to be enforced by either party, but was taken to be superseded

by the agreement then come to. After some fluctuation of opinion, he had come to the view that defendants were right, and that it was impossible to give any subtle meaning to the statement made by Mr. Cooper. The statement in plain terms amounted to this, that both parties regarded the agreement come to in reference to the terms of the Order was to supersede, and take the place of, the agreement of Nov. 5, 1909. The contention on the part of the plaintiffs was that this was not the true view of Mr. Cooper's statement, or what actually took place—that what he meant was the stipulation as to price and extensions on the west side were modifications and superseded those parts of the agreement of November, 1909. On the whole, it was impossible to give any other meaning to the words, and this showed, although there was no express stipulation, that the parties went on the footing that the agreement of Nov, 5, 1909, was from that time forward not to be operative, but was superseded by the provisions in the clauses. Having come to this conclusion, the rest of the case was not material. The defendants had alleged that if the agreement was not superseded by what took place in the committee-room it was superseded by the subsequent correspondence; and if it were necessary to decide the point, he should hold that the correspondence had not the effect contended for. But having come to the conclusion that what took place in the committee-room superseded the agreement, he must enter judgment for the defendants, with costs.

LONDON MAGISTRATE ON PREPAYMENT METERS.

Characterized as "Criminal Manufacturers."

At the Old Street Police Court, last Friday, William Kerridge, a lad of sixteen, living in Mintern Street, Hoxton, was charged with stealing from a prepayment gas-meter at that address 3s. 2d., the property of the Gas Light and Coke Company, on whose behalf Mr. Humphreys prosecuted. Prisoner admitted the offence, and, in answer to a question by the Magistrate, said he cut off the padlock with a file.

Addressing Mr. Humphreys, the MAGISTRATE said he considered that automatic gas-meters were responsible for the manufacture of young criminals. Scarcely a day passed but what some boy was charged before the Court with breaking open a meter belonging either to the prosecutors or to the Commercial Gas Company. In fact, the present charge was the second of the kind he had heard that morning. On the previous day, when another boy had been charged with a similar offence, a Solicitor representing the Gas Light and Coke Company stated that the Company had some 30,000 automatic meters broken open during the year. These meters manufactured criminals wholesale, and should be suppressed by Act of Parliament.

Mr. HUMPHREYS pointed out that automatic gas-meters were the greatest convenience to the public, who would suffer if they were done away with. Every effort was being made to render the meters thief-proof, short of building them like burglar-proof safes; and numbers had been made with the locks as part of the meter, instead of the old padlock fastening. But though the risk to the Company was decreased somewhat, that to the public was increased tenfold; for then the thieves tore down the meters, severing the connecting-pipes regardless of the escaping gas, which might easily cause a serious explosion and loss of life.

The MAGISTRATE: We had one case of a boy who disconnected the meter, turned it upside-down, and shook the money out through the slot by which it had been inserted.

Mr. HUMPHREYS said everything was being done by the Company that was humanly possible.

Prisoner, who expressed a wish to go to sea, was remanded in order to ascertain what could be done for him.

Electric Lighting of Cottages at Burton-upon-Trent.

At the meeting of the Burton-upon-Trent Town Council last Wednesday, the report presented by the Gas and Electricity Committee set forth that the Electricity Engineer (Mr. T. Hall) was anxious that certain cottage property should be wired for electric light, at a cost of £20—prepayment meters being utilized. Mr. Jenkins inquired as to the rents of the property in question; also as to whether the houses were arranged for gas lighting, and what the anticipated return would be from supplying them with electricity. Alderman Rowland said he was very reluctant to move an amendment that such a small matter as the lighting of the cottages should be referred back to the Committee, yet he thought they had acted rather on the principle that there was "nothing like leather." He did not blame them, but he could see no reason why they should spend £20 on the laying of electric wires. Mr. Bassett seconded the amendment. Mr. Tarver, who moved the adoption of the report in the absence of Alderman Lowe, said the Committee had given the matter their very careful consideration. Mr. Hall was anxious to test the electric lighting of small houses; and they desired to make the trial on their own cottages. The cottages were laid-out for gas. Their rents were 5s. 6d. per week; and it was estimated that an average annual revenue of 35s. per annum would accrue. He would accept the amendment, and it was unanimously passed.

Silsden Gas-Works Report.—The annual report of the Silsden Gas Committee shows that on the year's working the net profit on the gas undertaking amounted to £84. It should be borne in mind, however, that during the year £570 was taken out of the revenue to meet expenditure which is really of a capital nature. Had this not been done, the profit would have run to close on £650. Allowance had, of course, to be made for the excessive extra price of coal, which caused a total difference of £150 on the year's working. During the year the bye-products were disposed of at lower figures than in the preceding twelve months.

MISCELLANEOUS NEWS.

ANOTHER REDUCTION IN PRICE AT WIDNES.

It was announced at the monthly meeting of the Widnes Town Council last Tuesday that the Corporation had beaten their own record for the production of the cheapest gas, by a reduction of 1d. per 1000 cubic feet. At the same meeting, it was reported that the profits on the gas undertaking for last year amounted to £5268.

Mr. ISAAC CARR (the Gas Engineer), in reporting upon the revision of prices, recommended that as a result of the introduction of new carbonizing plant at the gas-works, the price of gas be reduced, as from July 1, by 1d. per 1000 cubic feet to ordinary consumers—making the price to consumers below 3,000,000 cubic feet per annum 1s. net per 1000 cubic feet; to consumers of over 3,000,000 feet, 10d. net; and to all users of gas for motive power purposes, 8d. net. He recommended that the concessions to slot-meter consumers be an increase in the amount of gas obtainable for a penny of from 54 to 60·6 cubic feet. This alteration in price would be equivalent to a reduction of 2d. per 1000 cubic feet, and would make the price received by the department from slot-meter consumers, after deducting the cost of maintenance of internal pipes and fittings, depreciation, and rents of meters, together with extra cost of collection, 11½d. per 1000 feet, or ½d. less than the price charged to ordinary consumers. He finally recommended that the department should undertake the maintenance, free of charge for labour, of modern incandescent burners and lamps used by consumers. The reductions and concessions would cost, he estimated, about £2600 per annum.

The Committee resolved that the recommendations be approved; and the confirmation of the minutes was moved by

Alderman SMITH, who said it was a unanimous decision of the Committee, which had not been arrived at without due deliberation. The Committee were quite satisfied with the information they had received from time to time from the Engineer, for it had always proved reliable, had always kept them up with records, and now he had broken his own. It was, indeed, unique that they produced gas at the universal price of 1s. per 1000 cubic feet; and he ventured to think householders would have cause to rejoice that such a step had been taken. The quantity of gas made during the year was 502 million cubic feet, against 454 millions for the previous year. The Widnes Gas-Works were comparable in size with such towns as Bury, Wigan, Southport, Warrington, St. Helens, and Preston, having two to three times the population of Widnes. The coal bill for the year compared with that of two years previous showed an increase of £4700. Notwithstanding this extra cost, together with a large falling off in the prices of tar and sulphate of ammonia, the profit was equal to that of the previous year; while the profits in the majority of undertakings showed large diminution—in some cases almost to disappearing point. The cost of manufacturing the gas per 1000 cubic feet was, notwithstanding the altered position with regard to coal and residuals, 4·6d., which was the lowest on record. The fact that the department to-day found itself in this excellent financial position, and in the position to recommend a reduction in the price of gas, was due to the introduction of modern methods of manufacture; and if the Council sanctioned the recommendation of the Committee, the selling price for motive power at Widnes would be 27 per cent. less than the nearest competitor—*i.e.*, the Sheffield Gas Company. The price to large consumers for lighting would be 23 per cent., and for small consumers for lighting 20 per cent., less than Sheffield. These prices would more firmly establish the position of Widnes as the suppliers of the cheapest gas in the world. The recommendation of the Committee to give a reduction of 2d. to slot consumers, as compared with 1d. to ordinary consumers, arose from the fact that the number of slot consumers, together with the increase in consumption, proportionately reduced the cost of maintenance, depreciation, and collection. When the last reduction in price was made, in 1911, the price to slot-meter consumers was set so that they were charged ½d. per 1000 cubic feet less than the ordinary consumer; but the increase had been such that the latest figures showed the receipts to be ½d. per 1000 cubic feet more than the price charged to the ordinary consumers. The proposed alteration would adjust the balance. In reply to questions, Alderman Smith said the cost of manufacture and distribution came out at 5 5d. per 1000 cubic feet, and the total cost, including all charges, to 9·9d. The meter and stove rents at present charged, especially in the small sizes, might be described as nominal; and altogether the income from these rents did not amount to ½d. per 1000 cubic feet. The Committee felt that in the case of gas-stoves it was better that a small rental should be charged, in order to prevent consumers who did not really require a stove having one lying on their premises and bringing in no return. In other words, the small rental charged was an assurance that the stove was required, and used. If they were fixed free, there was not the slightest doubt that many hundreds would be ordered, bringing in little or no return, and the cost of maintenance would be very materially increased. With regard to meter-rents, some gas authorities who had abolished them had had to reinstate them. For instance, the Gas Light and Coke Company found, as every other authority had found, where there was electric competition, that consumers kept gas-meters as a "stand-by," and the cost of maintaining these stand-by meters fell upon the ordinary consumers. On this ground alone the Committee were strongly of opinion that the nominal charges now made should be continued.

Mr. WELDING regretted that the Committee, in his opinion, had not given the matter sufficient attention when they were in a position to deal with it. It had struck him that, as the meters were put in, not for the use of the consumer, but solely by the vendor for his own convenience, they should be part of the standing charges, and not an additional charge on the consumer.

Mr. MILLAR said he appreciated the Committee's concession, or, rather, the giving back to the people part of a proportion of the profits to which they were entitled, and which their wealth had produced.

It was theirs, and they had a right to it. He thought, however, there might be some misconception as to the price to slot-meter consumers. It worked out that the gas would cost them 1s. 5d. per 1000 feet; and it seemed a large margin to charge for collection and fittings. He was a little disappointed that the Committee did not offer to free the meters and gas-cookers, inasmuch as there had been a demand for this, and none for a reduction in the price of gas. He noticed that the profits for 1913 were £5296, and for 1914 £5268, or £22 less. Included in the latter period were four months during which the new plant had been working. They were told that with the new plant there was to be an additional profit of £12,000. Where was this to be made in the remaining eight months? Take another phase of the question, he found that the wages bill at the gas-works for June last year was £295 per week; while the wages bill in 1914 was £215, or a decrease of £80. This meant that in the year there would be a saving in wages of £4160. The Committee were giving back to the people £2000, when they had taken from them £4000 in wages. He thought that the reduction might have been arranged so that the smaller consumer could have more benefit.

Mr. G. DAVIES said he was disappointed at the great disparity between the prices charged to the power consumers and the ordinary consumers. He knew there was a good deal to be said for the "day-load"—that the power consumer took most of his gas in the day-time. But he believed that nowadays the ordinary consumer used more in the daytime than the power consumer; so the question of "day-load" did not enter at all. The Chairman stated that the cost of production was 9·9d. per 1000 cubic feet; and as the power consumer was getting it at 8d., it was being supplied at nearly 2d. less than cost price. He said this principle was a vicious one. No corporation had any right to manufacture an article and sell it at less than its cost. To his mind, it would have been better to have reduced the price to the ordinary consumer by 2d., and to the 3,000,000 feet consumers by 1d., and let the power consumer stand where he was.

Alderman SMITH said the Committee had always been on the right side financially.

After some further discussion, the minutes were adopted *nem. con.*

WEST BROMWICH GAS REPORT.

The report and accounts of the West Bromwich Corporation gas undertaking for the twelve months ended March 31, which bear the signature of the Borough Treasurer (Mr. H. Kirk), and which, as already recorded [*ante*, p. 729] have been adopted by the Town Council, show that the total income of the undertaking for the year on revenue account amounted to £62,443, as compared with £62,791 the previous year—a decrease of £348. The net income from sales of gas amounted to £39,174, or an increase of £172. During the whole of the year the sales were made on a reduced scale of charges, which were only in operation during the last six months of the previous year.

The total quantity of gas sold was 367,104,762 cubic feet, an increase of 7,518,023 cubic feet. The total average price per 1000 cubic feet of gas sold was 2s. 2·5d. The number of houses in the borough in November last was 14,825; and of these 5917 are supplied through ordinary meters, and 6086 by prepayment meters—a total of 12,003. The number of consumers of all classes at the end of the financial year was 12,314, an increase of 228. The total length of mains laid is 50 miles 1501 yards; and the number of consumers per mile of main is 242, as compared with 247 last year.

As to residual products, the amount derived from this source during the year was £19,509, as compared with £20,186 the previous year, a decrease of £677. The income from the sale of gas-fittings, the sale and hire of stoves, and for the maintenance of incandescent burners and mantles on consumers' premises amounted to £2657; while that for lighting and repairing public lamps was £1101. The total expenditure on revenue account amounted to £52,249, being an increase of £2565.

The net cost of manufacture, after deducting the income from residual products, was 1s. 1d. per 1000 cubic feet, as compared with 10·86d. the previous year, or an increase of 2·14d. Coal, oil, &c., cost 1½d. more, while the residuals produced 1d. per 1000 cubic feet less than the previous year. The gross profit carried to the net revenue account was £10,193, against £13,107 the previous year. The net revenue account has been charged with £8955, being £3251 in respect of interest on loans and Corporation stock, and £5703 for instalments towards the redemption of loans. After these charges, there remains a net surplus for the year amounting to £1238, or a decrease of £3585 on that for the previous year. The appropriation account shows a balance of £18,138 brought forward from the previous year, of which £500 was applied in aid of the general district rate. With the net profit of £1238 for the year, there is a balance forward of £18,876.

DEVONPORT CORPORATION GAS UNDERTAKING.

Last Year's Working.

The annual statement of the Borough Treasurer, Mr. H. J. Hoare, in reference to the gas-works fund was under consideration at the meeting of the Devonport Town Council last Thursday. During the year ended the 31st of March last, the quantity of gas sold was 460,625,000 cubic feet—an increase of 36,389,000 cubic feet on the previous year. The total revenue was £81,098, of which £54,497 was from the sale of gas, £15,159 from residuals, and £7772 from rentals of meters and fittings. The expenditure on revenue account was £59,983; leaving a gross profit of £21,115, and a balance, after paying interest and allowing for redemption of stock, of £2710. This sum was transferred to the reserve fund, from which there had been paid during the year £1113 for the renewal of retorts, £1200 on account of the contract for telpher plant, and £1277 in respect of that for stoking machinery. The working statement showed that 29,147 tons of coal and 222,527 gallons of oil were used, and that the average cost per ton of the material carbonized, including delivery, was 17s. 0·46d., against 15s. 1·82d. last year. The gas made per ton of coal or its equivalent was 12,318 cubic feet, compared with 10,512 cubic feet before. The coke and breeze made was 19,427 tons, carbon 6 tons, tar 1762 tons, and sulphate of ammonia 248 tons; the average net prices obtained per ton being for coke 12s. 3·44d., tar £1 5s. 9·55d., and sulphate of ammonia £6 15s. 8·25d. Worked out on the basis of 1000 cubic feet of gas sold, the revenue from sales of gas was 2s. 4·39d., compared with 2s. 4·48d. before. The cost of manufacture, &c., was 2s. 4·29d., against 2s. 7·35d.; and the net cost, after allowing for the receipts from residuals, meter-rents, &c., 1s. 5·39d., against 1s. 6·94d., showing a gross profit of 11d. per 1000 cubic feet, against 9·54d. Last year there was a deficit equal to 1·97d. per 1000 cubic feet of gas sold, and this year there is a profit of 1·41d.

Alderman Tozer, the Chairman of the Gas Committee, congratulated the Council on the fact that there was this year a considerable profit on the working of the undertaking. There was a satisfactory increase in the sale of gas, and the cost of manufacture had been reduced by 2d. per 1000 cubic feet. This was very gratifying, especially in view of the fact that the benefit of the installation of new plant had been experienced for only one-fifth of the year; for it was not completed until the middle of January. The Committee were very proud to be in so satisfactory a position. By the end of the next financial year they hoped to show a profit of £6000 or £7000. They would then be able to allocate £2000 to the reserve fund, and either reduce the rates by 4d. in the pound or the price of gas by 3d. per 1000 cubic feet. Mr. George criticized the Chairman's rosy forecast of the result of the present year's working. Mr. Littleton, however, thought that, instead of criticism, the Committee merited congratulation. They had turned a deficiency into a profit, and transferred £2700 to the reserve fund; and there was no reason to think that the results just achieved would not be improved upon during the current year. Alderman Tozer remarked that better management of the gas undertaking had brought about the improved position.

TIVERTON CORPORATION GAS UNDERTAKING.

The Past Year's Working.

At the Meeting of the Tiverton Town Council on Monday last week, the Chairman of the Lighting Committee (Alderman John Thorne) submitted the results of the working of the gas undertaking in the past financial year. He said the sale of gas produced £7993, and that of residuals £2791. Other receipts amounted to £92; making a total of £10,876, against last year's total of £10,621. The expenditure had been £7868; leaving a gross profit of £3008, against £3384. The interest on loans and instalments and repayment of sinking fund absorbed £2884; leaving a net profit of £124, compared with £636. Alderman Thorne explained the cause of the diminution in the profits. He said that twelve months ago they lowered the price of gas by 3d. per 1000 cubic feet; and this reduction had been in force for three-quarters of a year. The coal purchased last year cost on an average 1s. 6d. per ton more than was paid before. The Committee calculated that these two items would absorb at least £700; and the estimate had been fairly justified. But though there had been this additional charge upon the undertaking, they had been able again to show a net balance of £124. Obviously this was a small amount to be applied in relief of the rates. The Committee therefore suggested that it should be added to the reserve fund. They felt that they were very much indebted to the skilful way in which the gas-works were supervised by the Manager (Mr. Clark Jeffery). They also wished to give a word of praise for the loyal way in which the whole of the staff had supported him in bringing about such satisfactory results. The Manager would agree with him when he said it would be impossible to achieve such good results unless the men obeyed his instructions. It might be interesting to the Council to look at the present position of the gas undertaking. From the commencement there had been raised by loan for the original purchase and for additional plant and mains the sum of £39,313. Of this amount they had repaid £19,461, and a sinking fund had since been accumulated of £4585; making a total of £24,046, and leaving a total indebtedness of £15,267. He thought every business man present would agree that this achievement was eminently satisfactory. The town owned one of the most progressive concerns, and possessed one of the most up-to-date gas undertakings in the West of England. During the year the make of gas had been 49 million cubic feet of gas—an increase of 2½ millions over the previous year. In the past twelve months they had fixed 100 new stoves and 100 new prepayment meters. The new stoves represented 100 new customers whose consumption was small; but this was the class to whom they had to look for a great deal of the success of the undertaking. They wished to provide an article which would be of the greatest service to the humblest cottager in their radius. The Mayor (Mr. A. T. Gregory) said the Council were greatly indebted to the Manager and his staff, and also to the Chairman of the Lighting Committee. It was no small thing to have carried on so satisfactorily a business enterprise of such large dimensions as the gas undertaking.

Portsmouth Water Company's Charges.—The recent increase in charges by the Portsmouth Water Company was last Tuesday the subject of a protesting resolution by the Town Council, whose members were indignant, more especially after the benefits conferred upon the Company a few years since by the water-rate being levied upon the town assessments in lieu of the rentals of premises. An excusing communication was read from the Company, whose Secretary wrote that the change had come about by reason of certain declarations by the Law Courts, and by an expenditure of £80,000 on works of filtration and the erection of an additional reservoir. But he pointed out that though the addition was only 3d. per quarter for each second closet and 3d. for baths, the sums were respectively 20 and 50 per cent. below the statutory charges. The protesting resolution was carried unanimously; and it was decided that a deputation from the Council should interview the Directors of the Company.

THE LONG EATON JUDGMENT.

Public Discussion Burked.—The Council to Appeal.

Not unnaturally, from their irreconcilable standpoint, a feeling of chagrin prevails among some members of the Long Eaton Urban District Council regarding the recent judgment of the High Court putting a sharp check to their attempted unfair competition with the Gas Company by the offer of preferential rates for electricity supply.

The matter came up for consideration at a meeting of the Council on Monday in last week, under the chairmanship of Mr. W. Johnson, when there was a numerous attendance of ratepayers in anticipation of some further light being thrown upon the reasons actuating the majority of the representatives in taking the action condemned by Mr. Justice Sargant. There was early apparent, however, a determination to burke discussion in public; and though a strong attempt was made to secure that the whole matter should be openly debated, the resolution for dealing with it with closed doors was carried—much to the disappointment of many ratepayers, who did not hesitate to show their resentment at the decision. It being obvious that the state of public feeling in the town will not permit of the subject being entirely stifled in this way, a partial promise was forthcoming of ultimate full and open discussion, wherein it was claimed in advance that the action of the Council would be abundantly justified.

Mr. J. B. MASKELL asked by whose authority it had been notified upon the day's *agenda* that the case would be discussed in Committee? Before any such course was resorted to, he should like to have the decision of the Council. At the present time they were faced by a serious crisis in connection with this unfortunate business. There was no doubt that there existed in the town a strong feeling of resentment at the policy of secrecy which had been adopted by the Council. The ratepayers were entitled to know the facts. It seemed to him that, since the Council rejected the Gas Company's offer of arbitration, a number of serious mistakes and blunders had been committed.

The CHAIRMAN said he was afraid that he could not allow any discussion to take place on the general question. They could realize why it had been arranged that the matter should be dealt with in Committee—this course having been adopted by the Sub-Committee acting upon the advice of the Clerk (Mr. E. Williams). It was desirable that the matter should be proceeded with in this way. They could all wish that it should be debated in public. But important questions were involved; and, acting upon the view of their legal adviser, they deemed it desirable, in the best interests of the Council and of the ratepayers, that it should be taken in Committee.

Mr. MASKELL moved that the discussion should proceed in public in presence of ratepayers and representatives of the Press.

Mr. J. RICHARDSON seconded the proposal, urging that, as judgment had been delivered, there was nothing to conceal.

Mr. S. TRUMAN moved, as an amendment, that the matter should be taken in Committee, stating that he was as anxious as Mr. Maskell was that the facts of the case should be stated in public; and he was determined for one that they should be stated there or in the Market Place. It was desirable, however, in the first place that all the members of the Council should be placed in possession of the facts, and understand what they were going to do as an elected body not responsible to the Gas Company nor to its shareholders, and not responsible either to the "Long Eaton Advertiser," but to the general body of the Long Eaton inhabitants. They could not do with a partial Press dealing with the proceedings which occurred in that room. They had grave reason to complain of the one-sided character of the inspired reports emanating from a certain newspaper in Long Eaton.

Mr. MASKELL asked the Chairman whether it was fair that he should have been stopped when Mr. Truman was allowed to proceed.

The CHAIRMAN: Mr. Truman is not arguing the affairs of the Gas Company.

Mr. TRUMAN: I stand without being in any way implicated for the Gas Company. If Mr. Maskell is dissociated from the Gas Company, why should he be afraid of my stating the case in public?

The CHAIRMAN: You will not mention the Gas Company.

Mr. TRUMAN said they were not dealing with the case now. He was referring to the attitude of the Press. On the morrow of the judgment there was a suggestion made that they should have a town's meeting. He was not afraid of a town's meeting nor of the vote which he had given upon this issue, notwithstanding all the bias and spleen which had been shown and the half reporting of speeches in the Long Eaton Press. He had a distinct recollection of what occurred at the outset of the campaign in relation to the electricity undertaking, and of the fact that the Gas Company's representatives fared very badly as to their objections when the electors were made aware of the facts. They were not willing that their interests should be handed over to a private Company, and that the electricity undertaking should be crippled. They had good reason for dealing with the matter at this stage in private. They did not want any more garbled reports appearing in the local Press.

Mr. MASKELL urged that the Chairman had treated him unfairly in allowing Mr. Truman to enter into these matters when he had stopped him from discussing them.

Mr. TRUMAN said he would, in face of Mr. Maskell's objection, withdraw his observations, and deal with the matter in Committee.

The CHAIRMAN said he must object to Mr. Truman, as he had done to Mr. Maskell, entering upon any public discussion at this stage.

Mr. TRUMAN proposed that the matter should be discussed in Committee.

Mr. S. H. HICKLING seconded the amendment; stating that in due time the ratepayers would know the whole of the facts.

The amendment was carried by 14 votes to 3; and the Council afterwards proceeded to the consideration of the matter in Committee.

Judgment to be Appealed Against.

The Council in Committee decided, by twelve votes to five (one member being absent from the meeting) to appeal against Mr. Justice Sargant's judgment; it being understood—says our local correspondent—that legal opinion favourable to this course had been obtained. The decision is in accordance with expectations which had been entertained locally; the controversy having engendered a somewhat bitter feeling at Long Eaton. But obviously the issue is not limited in its far-reaching consequences to the action of any one authority. A principle of extreme gravity is involved; and it is understood that the Long Eaton Council are receiving support from some other public bodies which are similarly affected—notably one having charge of important interests in a southern borough. On the other side the Long Eaton Gas Company, who have fought against a notoriously unfair system, are not likely to lack material support from quarters which are quite as influential.

NOTTINGHAM STREET LIGHTING.

Stung by the reproach which has been levelled against Nottingham of late, of being one of the worst lighted towns in the Midlands, members of the Corporation seem determined on effecting a remedy which has been too long delayed. Leicester and other neighbouring towns have made such advances in recent years in the matter of street illumination, that Nottingham's arrangements appear for the greater part hopelessly archaic. The criticism has applied not only to the suburban districts, where the continuance of antiquated burners has been unworthy of a centre of commercial importance, but it has had reference also to many of the main business thoroughfares. Within the past few months, however, some marked improvements have been effected in the streets contiguous to the Market Place; attention having been wisely directed to the installation of high-pressure lamps on the line of traffic from the Midland Station. But there is a desire locally for more advanced methods; a proposal being brought forward at the last meeting of the Council yesterday week that it should be an instruction to the Lighting Committee to confer with the Electrical Engineer, with a view to arrange for experiments being carried out in certain streets by suspending metal filament electric lamps from cables across the streets or attached to the tramway standards.

Mr. GIBSON, who was responsible for the resolution, disclaimed the idea that it was intended in any way to be regarded as antagonistic to the Lighting Committee or the Gas Committee. His desire was to remove the stigma which rested upon Nottingham of being one of the worst-lighted towns. In their determination to effect improvements, the Lighting Committee had devoted their attention principally to the matter of high-pressure gas-lamps. The resolution which he proposed would authorize them to experiment with electricity out of funds specially set apart for the purpose. He suggested that the Committee should be empowered to undertake necessary experiments. The question of expense need not enter into consideration. The proprietors of what was known as the Barrow system would undertake to make the installation and render all the assistance necessary—carrying out the work for a considerable time at a very reasonable cost. With electric lamps, either suspended from cables across the streets or attached to the tramway standards, they might be able to get rid of many of the old-fashioned lamps which were being used at the present time.

Mr. HUTTON, who seconded the resolution, declared that Nottingham was one of the worst-lighted cities in the country.

Mr. E. RICHARDS, a member of the Lighting Committee, expressed the view that the resolution ought never to have been put on the *agenda*. The matter should have been brought before the Lighting Committee. Mr. Gibson was a member of the Committee; and he must know that there was a Sub-Committee now engaged in investigating the very thing he had been talking about. As far as he (Mr. Richards) knew, experts were in favour of installing arc lamps; which had been placed in various parts of the city to improve the street lighting, at the main junctions particularly; but Mr. Gibson desired that it should be an instruction to the Electrical Engineer to confer with the Lighting Committee. He moved the reference of the matter to the Lighting Committee.

Mr. BOWLES seconded the amendment, suggesting that Mr. Gibson would have served a more useful purpose if he had first given the Lighting Committee the benefit of his ideas. Mr. Hutton was also a member of the Committee; and might have followed a like course.

Mr. R. H. SWAIN, the Chairman of the Tramway Committee, pointed out that lamps could not be attached to the tramway standards against Board of Trade regulations.

After further discussion the Council adopted Mr. Richard's amendment, referring the matter to the Lighting Committee.

MALTA AND MEDITERRANEAN GAS COMPANY.

Satisfactory Position Maintained.

The Ordinary General Meeting of this Company was held last Tuesday, at the London Offices, Nos. 59-60, Gracechurch Street, E.C.—Colonel JAMES LEGEYT DANIELL in the chair.

The SECRETARY (Mr. A. W. Cooper) read the notice convening the meeting and the certificate of the Auditors; and the report of the Directors and the statement of accounts were taken as read.

The CHAIRMAN pointed out that the report and accounts showed such a remarkable similarity to those of the preceding year that he did not propose to go into them in detail. The difference between the two years' business was in favour of the past year, which showed up better all round. There were 443 tons more coal used; and the quantity of gas sold increased by 2,515,000 cubic feet, which was equivalent to 2·14 per cent. There was a decrease in the outlay on maintenance of £471; and the balance of profit and loss account carried to general revenue account was £10,631, against £9846 for the preceding year. By the general balance-sheet, it would be seen that the reserve account stood, after adding £2000 as had been done on the present occasion, at £7000; while the amortisement account figured at £42,317. A glance at the item of investments would indicate that they had been able to add £1436, the cost of £600 of Bank

stock, to the securities already held. It was comforting to know that in the present accounts there had been no necessity for writing-down values. As a matter of fact, instead of depreciation a small appreciation was shown. Taking the works in detail, he would refer first to the Sicilian stations, though they were not of such importance as the main station at Malta. The business at Trapani had received a check from the competition of the electric light. Indeed, their officer who went round from Malta told them that the private consumption had practically gone to the Electric Light Company—that everybody in the place was taking current, because they all of them held shares in the Company. Electricity was being sold at unheard-of prices, which to the consumers were no doubt satisfactory, but which when regarded from the point of view of the shareholder might not be so pleasing. Mr. Reid, their Chief Engineer at Malta, who had superintended these stations, said that at Marsala the business was very small. It showed a profit, but was not very satisfactory; and the Board had arranged for Mr. Reid to come over to London and discuss matters. It was encouraging to note that at Malta they were holding their own, in face of the competition with the Government electric lighting. He called it Government electricity because, at those present knew, the money for the works was found from the reserve fund at Malta belonging to the Government. The sales of gas there showed an increase as compared with 1913, which year also exhibited a small increase over its immediate predecessor. The make of gas per ton was better at 12,405 cubic feet, which was a very satisfactory figure. A new contract had just been made with the Admiralty Department for three years, at a slightly better price than before; and this might in a measure compensate for the loss that would be sustained through the Ricasoli Barracks having gone over to electricity. There were, of course, other ways besides lighting of making money out of gas; and this was one of the points they would discuss with Mr. Reid. The General Manager at Malta (Mr. Starkey) was quite alive to the fact that it was necessary to push the use of gas for heating, cooking, and other purposes; and the Board would give him, and those working with him, every encouragement in doing so. A remarkable instance of the utility of gas for water heating might be quoted from his own recent experience. In a house which he had in London—an old one, it should be said—it was found that the chimneys were getting overheated; and he called in a firm of builders. Contrary to the advice which they gave him, it seemed to him that the only thing to do was to reduce the quantity of heat passing up the chimney by disconnecting the boiler which supplied the house with hot water, and putting in a small gas-boiler. After six months' trial, he requested a builder in whom he had great confidence to inspect the installation and cross-examine the servants, and furnish a report upon the matter. The report was that the gas-boiler was superior to the old system of heating from the range-boiler—that the water was heated for domestic purposes and baths in much less time, and that the heat was easily maintained. In this way, a saving of coal had been effected which had certainly paid the gas bill. If this result could be obtained in London, how much greater would be the advantage and comfort derived in hot climates such as Malta and similar places. He concluded by moving the adoption of the report and accounts.

Colonel STEPHENSON R. CLARKE seconded the motion.

Mr. F. R. SMITH said he would be glad of some information as to the debts owing to the Company in connection with the Sicilian stations.

The CHAIRMAN replied that the debt at the larger place, Trapani, had been reduced; and it was in the hands of a Royal Commissioner at Marsala to make the authorities apply such portion of their revenues as they could to the payment of the debt there. The amount was not very large.

The resolution was then carried unanimously.

On the proposition of the CHAIRMAN, seconded by Mr. A. M. PADDON, it was agreed that dividends at the rate of 7 per cent. on the first preference shares, 7½ per cent. on the second preference shares, and 6 per cent. on the ordinary shares be declared for the year ended March 31—deducting the payments made on account.

The retiring Director (Colonel Daniell) was next re-elected, on the motion of Colonel CLARKE, seconded by Mr. A. W. OKE; and the Auditors (Messrs. R. H. Jones and T. Guyatt) were reappointed on the proposition of Mr. JOSEPH CASH, seconded by Mr. E. L. BURTON.

Mr. SMITH proposed a hearty vote of thanks to the Chairman and Directors; remarking that the balance-sheet was a most satisfactory one.

Mr. W. H. DODGSON seconded the resolution, which was cordially agreed to.

The CHAIRMAN, after acknowledging the compliment, moved a similar vote to the staff—mentioning Mr. Cooper, Mr. Starkey, Mr. Reid, as well as the two Managers at the Sicilian stations, who, he remarked, had done their best under difficult circumstances.

Mr. CASH seconded the proposition, which was cordially agreed to, and acknowledged by the SECRETARY.

LOUGHBOROUGH GAS UNDERTAKING.

If the results attendant on last year's working of the Loughborough Corporation gas undertaking compare somewhat unfavourably with those of the previous twelve months, the figures cannot be deemed unsatisfactory, having regard to the higher expenditure which has had to be incurred in production.

Presenting the annual report of the Committee at a meeting of the Council on Monday last week, Mr. W. F. Charles (the Chairman) explained that the profit for the year had amounted to £7884, as against £9403 in the preceding period; the decrease being accounted for by the increased cost of coal, oil, labour, and distribution, and a reduction in the price of 2d. per 1000 cubic feet. The increase in the

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production of gas had been small—amounting to only 16,000 cubic feet—and it seemed that they had reached the maximum of their output under existing conditions. There were, however, means by which the consumption of gas in the district might possibly be stimulated; and in this connection he suggested encouraging the use of gas-fires in cottages, expressing the hope that a scheme might be brought forward under which such supplies could be furnished on the instalment system. He did not think the output of gas from the amount of coal carbonized had been quite as good as it ought to be; and he hoped that when the new plant was installed there would be a considerable advance. In spite of the general fall in the price of residuals, they had sold them well. He favoured the use of high-pressure gas for lighting the centre of the town and shop fronts.

The Council adopted the report, and decided to increase the salary of the Engineer (Mr. E. Onions) from £350 to £375 per annum.

HINCKLEY GAS-WORKS STATISTICS.

The annual report of Mr. Fred Lee, the Manager of Hinckley Gas-Works, which was presented at a meeting of the Urban District Council last Tuesday evening, stated that in the capital account the total expenditure for the year was £1140; the whole amount having been spent on new mains and services, meters, and cookers. The total loan liability was now £26,640 (a reduction during the year of £2581). The sum of £1000 had been transferred to the general district fund—£500 for the relief of the rates, and £500 for the purchase of 5 acres of ground. The total receipts were £17,139, being a decrease of £567, though an increased quantity of gas had been sold. This was caused by a reduction in the price of gas, which represented £582 less than if the same price as before had been received. Though more coal had been used, receipts from residual products were £173 less, owing to the lower prices obtained for coke and sulphate. The total expenditure was £14,977, being £1206 more. There had been 9300 tons of coal used, and 102,510,000 cubic feet of gas made. The gas sold was 99,202,000 cubic feet. There were 1,537,000 cubic feet used on the works, and 1,771,000 cubic feet (or 1·73 per cent.) unaccounted for. There was an increase of 143 in the number of meters in use; while 142 additional cookers had been fixed. As a result of the exhibition held in October last, 164 gas-fires had been installed. Though the profit shown was less than last year, if the Council took into consideration the exceptional cost of materials, and the reduction in the price of gas and residual products (there were very few works of the same size selling gas so cheaply), he thought they would admit the result of the year's working was quite satisfactory.

In moving the adoption of the report, Mr. W. H. Bott (the Chairman of the Gas Committee) said it would be noticed that the result was a net profit of £2161, compared with £3935 last year. It was satisfactory to be able to show so good a result, in face of higher prices of all materials—especially coal; and at the same time to reduce the price of gas by 3d. per 1000 cubic feet during the past two years. Had the same price been charged for gas as in 1910, the consumers would be paying £1570 more than at present; and if the same price had been charged as in 1904, the extra amount paid over the present price would have been £3939. It was also worthy of notice that the price of coal was 3s per ton more than it was in 1910. The Council would notice that £2581 had been paid off loan account, leaving the present liability £26,640, or 5s. 4d. per 1000 cubic feet of gas sold; being a reduction of 8d. per 1000 feet during the year. They had transferred £1676 spent on capital account and special renewals account from profits. There was no doubt the policy of the Council in paying for extensions out of profits had helped in a large measure to place the gas-works in the strong financial position they occupied to-day; and had this not been done, the price of gas would have been considerably higher. In 1904, the loans were £40,950; in 1914, £26,640—a decrease of £14,310. In 1904, the loans per 1000 cubic feet of gas sold were 16s. 5d.; in 1914, 5s. 4d.—a decrease of 11s. 1d. In 1904, the price of gas per 1000 cubic feet was 3s. 4d.; in 1914, 2s. 6d.—a decrease of 10d. In 1904, the gas sold was 49,844,000 cubic feet; in 1914, 99,202,000 feet—an increase of 49,358,000 feet. The Council would agree that the year's working had been satisfactory.

Mr. Cholerton thought the figures were very satisfactory, having regard to the considerable reduction foreshadowed some months ago. Much credit was due to Mr. Lee for presenting so excellent a report. The Chairman (Mr. G. Kinton) said one of the features of the report was that the Council were enabled to pay £2600 off loans account.

The report was unanimously accepted.

It was decided to reduce the price of gas supplied for engines to the neighbouring parish of Burbage as follows: 1s. 9d. per 1000 cubic feet, when the consumption was over 100,000 feet per quarter; 1s. 11d. per 1000 cubic feet, when the consumption was from 50,000 to 100,000 feet per quarter; and 2s. 1d. per 1000 cubic feet, when the consumption was less than 50,000 cubic feet per quarter.

COCKERMOUTH GAS-WORKS REPORT.

Mention was made in last week's issue of the satisfaction felt by the Cockermouth Urban District Council at the results of the past year's working of the gas undertaking; and of the fact that the services of the Manager (Mr. E. D. Wootten) had been acknowledged by an increase of salary.

In his report, which was for the year ended March 31, Mr. Wootten stated that in most ways the year was a record one. One outstanding feature was the high price of coal—16s. 7½d. per ton, as against

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Cavendish Works, BALHAM, LONDON.

13s. 4½d. for the year ended March 31, 1910. The make of gas for the year was 30,728,000 cubic feet—surpassing the previous year's record. The gross profit was £1186, as against £892. Payments of interest on loans were £413, and sinking fund payments £464, leaving a net profit for the year of £309, against a deficit of £66 last year. The revenue from gas sales and stove hire was greater by £232; the total being £4002. The net return from residuals was much improved; being £1358, as against £1081. The total increase in revenue was £484. The working results also showed marked improvement. The yield of gas per ton of coal carbonized was 11,045 cubic feet, against 10,598 cubic feet; the tar yield was 13·09 gallons per ton, against 11·14 gallons; the sulphate of ammonia yield was improved owing to alterations made to the liming apparatus; and the coke saleable was 9·77 cwt. per ton of coal, against 8·3 cwt. The number of consumers was 26 more; and 49 gas-fires were fixed during the year. This record output was to be attributed to the Council's policy of advertisement and to the hygienic efficiency of the modern gas-fire. "Smell" and "gas-fire" were fast ceasing to be associated ideas; and the popularity of the gas-fire was rapidly increasing. The town of Bath averaged one gas-fire to each consumer. In Cockermouth, with gas at the reasonable price of 2s. 9d. per 1000 cubic feet, and the attractive hire-purchase terms offered, there was no reason why the average should not rapidly approach that of Bath.

BLACKBURN STRIKE AFTERMATH.

Borough Treasurer's Report—Automatic Street Lighting to be Considered.

The Town Council have authorized a Sub-Committee to prepare a scheme for automatic street lighting in the town. This departure is one result of the recent municipal strike, which cost some thousands of pounds. A statement as to the cost of the strike of the municipal employees has been issued by the Borough Treasurer (Mr. J. H. Bailey), and gives the following particulars.

The loss of income from the sale of gas during the period of the strike may be taken at about £15,550. An estimate can only be made of the net profit which would have been derived from this increased income. The additional cost of manufacture would have been about £7000; so that the loss of the net income may be taken at approximately £8500. The increase in expenditure directly due to the strike is: Payments of the Strike Committee, £5947—less total reduction in ordinary wages during the strike period, £2147—thus making the total cost of the department £12,300.

Dealing with the Water Department, the Treasurer says there was a total decrease in wages of about £70 during the strike period. As, however, this was wholly in respect of repairs to mains and service-pipes (which work was only deferred to a later period), the effect upon the department was practically *nil*.

THE SUMMARY.

Gas-works, cost of strike	£12,300
Water-works	*Nil*
Electricity	*Nil*
Police	2,278
	£14,578
Less:	
Highways, cleansing, baths, and lamps saved by the strike	2,250
Net cost of strike	£12,328

THE RIVER THAMES AND THE EARLY GAS-WORKS.

Our contemporary the "Daily Chronicle" recently contained the following paragraph under the heading of "The Office Window": "London in 2014, as imagined by Sir Aston Webb, with men fishing for salmon and trout off the Embankment, would in some respects be a reversion to London in 1814. The 'Annual Register' records that on June 11, 1821, 'a fisherman was charged at the Mansion House, before the Lord Mayor, with using an unlawful net. He pleaded in his defence that the discharge from the gas factories had ruined the Thames fishing. He used to catch large quantities of shad and smelt off the Temple; but these fish had almost entirely disappeared, and he was compelled to use an illegal net to catch the few there were. Salmon was formerly caught in abundance; but during the past year only one had been caught. The Lord Mayor expressed regret at the distress to which the fisherman had been reduced, and mitigated the penalty.'"

This is borne out by the Medical Officer of Health for the City of London in 1854 and 1855, for in those years Mr. John Simon, writing from Upper Grosvenor Street, went very fully into the complaints of nuisance from the London gas-works. He dealt with the whole process of purification as then carried out by the Companies, and particularly with the "blue billy," the discharge of which into the Thames was regarded in the light of a common nuisance. It appears that in the works of the old City of London Gas Company at Whitefriars Dock wet-lime purifiers were in use. The gas bubbled through great churning-tubs of milk of lime, leaving in them its sulphuretted hydrogen combined with sulphuret of calcium. These, being of no commercial value, were, at certain states of the tide, discharged at night into the middle of the river. The Company, however, in consequence of legal proceedings, pledged themselves to effect an abatement of the nuisance; and they completed a system of dry lime purification. As this gave a cartable refuse, they no longer polluted the river.

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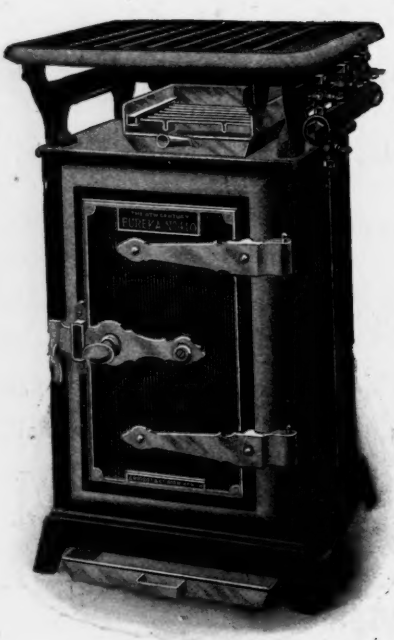

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ELECTRICITY v. GAS AT LONG EATON.

In pursuance of the policy of which the evidence forthcoming at the recent trial before Mr. Justice Sargant afforded abundant proof, the majority of the members of the Long Eaton Urban District Council appear, says our local correspondent, determined to stop at nothing in the way of expenditure upon the town's electricity undertaking, which is being run in a spirit of revengeful opposition to the Gas Company. Those who are concerned in the management of the latter's business are confronted by a by no means enviable task. Though the recent judgment of the High Court has been in the nature of a smart rap over the knuckles for those who desired to exploit a department of the local service upon preferential lines, there are still not wanting indications of a very bitter feeling which prompts antagonism to the enterprise of the Company of which Mr. George Stevenson—formerly himself a leading member of the Council—is Secretary and Manager. The opposition has been carried to an extent which can scarcely be deemed in consonance with equitable considerations; and though at the recent trial, as upon other occasions, Mr. Stevenson frankly stated that, upon a basis of fair trading, there was room, with possibly profitable results, for both undertakings, yet the bulk of members forming the local governing authority appear to be bent upon a policy which would leave no scope for the exploitation of any other than their own pet project—a singularly illuminating example of the negation of the Free Trade principles which certain Long Eaton politicians are never tired of proclaiming. At the last meeting of the District Council, the seal was affixed to a bond representing a further mortgage of £4000 for the extension of the electricity works; and the opportunity was utilized to sing the praises of the undertaking. Mr. Hickling observed that every month this year the Committee had been able to report an increase in the number of units sold, though the past month hardly compared favourably with the corresponding month of 1913; the reason being that Whitsuntide came within the former period, whereas it did not so occur this year. Had it been otherwise, the results they would have been able to report would be about equal to those of last year. The works of extension were shaping well, and would be completed in about a month, when, with everything installed, they would be in possession of a very fine works.

Fatal Accident at Ipswich.—An accident attended by fatal consequences happened to an employee at the Ipswich Gas-Works last Friday. Charles Smith, an ash picker, slipped from some iron steps on which he was standing, and so injured his head that he died.

Coke for Oldham Cotton Mills.—At the last meeting of the Oldham Gas Committee, it was reported by Mr. A. Andrew (the General Manager) that the stock of coke was slowly decreasing. Four mills were now using coke for steam raising, or were experimenting with it for this purpose.

NOTES FROM SCOTLAND.

From Our Own Correspondents.

Saturday.

The proposal made by Mr. MacLaurin to the Glasgow Corporation Gas Department for the manufacture of smokeless fuel is to carbonize the coal in a large vessel by passing hot gas through the material instead of applying heat to the outside of the vessel as in a retort. The patentee anticipates that by this method much less heat will be required, and also that the tar and oils will not be broken up as at present. He believes he will be able to provide practically double the quantity of tar oils with about 40 lbs. of sulphate of ammonia, as well as 10,000 cubic feet of gas of the quality at present supplied in Glasgow—17 to 18 candles. If the process turns out anything like so successful as the patentee anticipates, it will certainly be one which will be worth while looking into.

The Hamilton Town Council are extending the gas-works by taking over the existing stables belonging to the Cleansing Department, for which the Gas Department are paying the sum of £2000 to the Cleansing Department. While this appears a large sum, it is not so much when it is considered that the estimated cost of the new stables, including site, is £3400.

The Ellon Town Council have unanimously decided on the electric light agreement being signed by the Provost and Clerk. Plans for the lighting of the streets have been submitted, and permission is to be obtained from the proprietors of houses in certain streets to allow brackets and wires for the lights to be fixed on the houses, so that no poles would be required.

The Gas Committee of the Troon Town Council have had a communication from the District Clerks of the County Council asking upon what terms and conditions the Town Council will be prepared to supply gas to Barassie Special District. The Committee have agreed to recommend that a supply in bulk should be given through a meter at the burgh boundary, and that the County Committee be asked to provide and maintain the meter and pay £12 for fifteen years towards the cost of laying the pipe to the boundary. The price proposed to be charged for gas is 3d. per 1000 cubic feet above that charged from time to time in the burgh.

The members of the University Scientific Association of Aberdeen recently visited the Corporation gas-works. Such visits as these are always a matter of satisfaction for the gas profession. The more people with a scientific training can be shown that the gas as supplied is thoroughly purified and manufactured under thoroughly scientific principles, the better will the public believe in our product, and when information regarding gas is disseminated by people with such technical training, the effect upon the public is much more permanent and effective. Gas managers should encourage, and, in fact, go out of their way to obtain, such visits whenever possible.

The Cambuslang Gas Company, Limited, have held their annual

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THE "Main" value is good value. Honest workmanship, sensible design, excellence of material—these three combine in the production of "Main" Cookers and make them popular wherever used. Mains can fill your requirements satisfactorily.

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SHOW-ROOMS AND BRANCHES: 25, Princes Street, Oxford Circus, W.; 136, Renfield Street, GLASGOW; 56, Broad Street, BIRMINGHAM; 83, Old Market Street, BRISTOL; 13, Whitworth Street West, MANCHESTER; 97, Millfield, BELFAST; 333, Queen Street, MELBOURNE; and 12, Cunningham Lane, Pitt Street, SYDNEY, N.S.W.

general meeting, when Lieut.-Colonel Dodds presided. The net balance shown in the report is over £2613, which it has been decided to apportion as follows: £2160 for payment of a 6 per cent. dividend on the capital, which, with the interim dividend paid, makes 10 per cent. for the year. The balance, £453, is to be carried forward.

The Dunfermline Town Council have decided to extend their mains to Parkwick, *vid* Blackburn, in consequence of a petition from 45 residents in the former place, and have fixed the charge for gas at 5d. per 1000 cubic feet in excess of that charged to consumers within the burgh. Mr. A. Waddell has ascertained that all the signatories to the petition are agreeable to pay the additional 5d. proposed; so that ere long the people will be able to have gas introduced into their houses.

At the last meeting of the Kilmarnock Town Council, a "breeze" took place over the question of the contracts for coal—that the offers should not be made public. It was objected to by Bailie Climie that this business should not come up in the minutes; but the Provost and others pointed out that it was sound business for the Committee to get this remit from the Town Council. Bailie Davie remarked that those who were responsible for the concern wanted power to go into the market when they thought the proper time had come. They were studying the markets, and wanted to do the best they could for the town. They should allow their managers to go into the market at the proper time to purchase coal. The Provost said Kilmarnock for the last two years had been more successful than any corporation in Scotland in the matter of their coal contracts. The coal merchants would get the schedule which would be sent out to almost every person likely to offer. Eventually Bailie Climie did not press his amendment, and the Provost's motion was carried.

In view of the possibility of the supplanting of the electric lamps in a place like Edinburgh, it is all the more peculiar that so many of the smaller towns are discussing the introduction of electric light. Irvine has decided to take current from Kilmarnock in the same way as has been arranged for Troon. Aboyne and district, Ballater, and Ellon are obtaining Provisional Orders. Dalbeattie and Keith are also considering the matter; and yet in Edinburgh the public lighting price of current has had to be reduced owing to the success of gas.

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *June* 15.

During the past week the market for tar products has remained in a normal condition for this season of the year. Dealers have continued their efforts to write down prices, as is shown in particular by the pitch situation; dealers calling the value 32s. to 33s. net, while makers put it at 36s. 6d. As usual, the actual business for export now being done is practically *nil*. When the summer is over and sales of pitch commence, no doubt the price will improve; and in the meantime the tar available is going on the roads. During the month of May more than 1⅛ million gallons of tar were delivered for road purposes, in addition to considerable quantities of pitch, in the London district alone.

Other values are: Benzol 90 per cent., 1s. 2d. net and naked; toluol, 90 per cent., 11d. net and naked; solvent naphtha, 10¾d. net and naked; creosote, 3⅜d. to 3⅝d. net in bulk; sixties crude carbolic acid, 1s. 2d. net, casks free; pyridine, 8s. 7½d. net, in buyers' drums.

Sulphate of ammonia is still in an unsatisfactory position. It is understood that some makers have taken low prices in order to clear out stocks by June 30. Dealers are offering £9 17s. 6d. to £10 2s. 6d. net for 25 per cent. quality naked at makers' works; but makers will not sell thereat.

Tar and Tar Products in the Provinces.

June 15.

The average values during the week were: Tar, 24s. 3d. to 28s. 3d. Pitch, east coast, 32s. to 32s. 6d.; west coast, Manchester, 30s. 6d. to 31s. 6d.; Liverpool, 31s. 6d. to 32s. 6d.; Clyde, 31s. 6d. to 32s. 6d. Benzol, 90 per cent., naked, North, 10d. to 10½d.; 50-90 per cent., naked, North, 10d. to 10½d. Toluol, naked, North, 10½d. to 11d. Crude naphtha, in bulk, North, 4⅜d. to 5d. Solvent naphtha, naked, North, 9¼d. to 9½d. f.o.b. Heavy naphtha, naked, North, 9d. to 9⅛d. f.o.b. Creosote, in bulk, North, 3¼d. to 3⅜d. Heavy oils, in bulk, 3⅜d. to 4⅛d. Carbolic acid, casks included, 60 per cent., prompt, east and west coasts, 1s. 1d. to 1s. 1½d. Naphthalene, £4 10s. to £10; salts, 55s. to 60s., bags included. Anthracene, "A" quality, 1½d. to 1⅝d.; "B" quality, nominally, ¾d. per unit, packages included and delivered.

Sulphate of Ammonia Prices in the Provinces.

LIVERPOOL, *June* 13.

During the past week the market for this material has continued of an idle character, and the supplies which have come forth have been in excess of demand for early delivery. The decline in prices has only been slow, but it has not yet been arrested, and the closing quotations are £10 8s. 9d. per ton f.o.b. Hull, £10 10s. per ton f.o.b. Liverpool, and £10 12s. 6d. per ton f.o.b. Leith. In the forward position makers seem to have realized more fully the weakness in the situation, and it has transpired that first-hand business has been done for July-December delivery at £10 12s. 6d. per ton f.o.b. good port.

Nitrate of Soda.

The tone of this market continues quiet but steady at 9s. 10½d. per cwt. for ordinary, and 10s. 1½d. for refined quality on spot.

From another source it is reported that although prices of sulphate of ammonia have not fallen any further, the market is decidedly weak, and for the prompt position it is almost impossible to sell on the basis of to-day's quotations. Outside London, makes are quoted at £9 17s. 6d.; Hull, £10 8s. 9d.; Liverpool, £10 8s. 9d. to £10 10s.; Leith, £10 10s. to £10 11s. 3d.; Middlesbrough, £10 8s. 9d.

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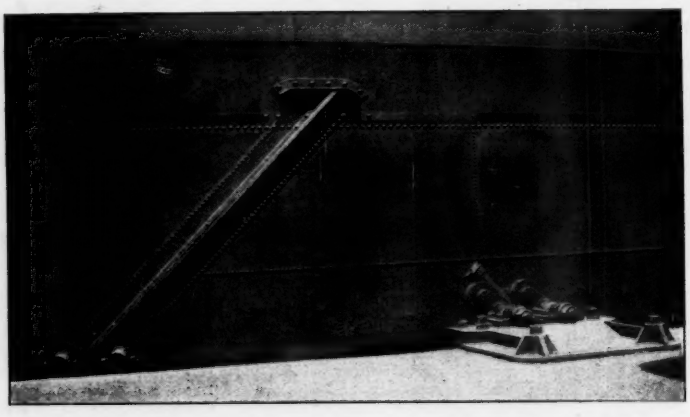

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MANCHESTER.

COAL TRADE REPORT.

Northern Coal Trade.

The coal trade is easier, because of a momentary scarcity of steamships. There is, however, a fair general demand. In steam coals, best Northumbrians are about 14s. 3d. per ton f.o.b.; and second-class steams are from 12s. to 12s. 3d. per ton. Steam smalls are relatively steady at 7s. 9d. to 8s. 9d. per ton f.o.b., and are in full demand; the output being well taken up. In gas coal, there is a fair inquiry. Best Durham gas coal is from 13s. per ton f.o.b.; second-class kinds are near 12s. 3d. per ton; and "Wear specials" are quoted at 13s. 6d. to 13s. 9d. per ton f.o.b. But a good arrival of steam tonnage would stiffen the market. A few contracts are in course of negotiation; and while for near delivery prices proximate those given, where the delivery is forward—into next year—about 12s. 4½d. seems to be quoted for best Durhams. It is, however, the expectation of some buyers that the prices will be lower, though it will be difficult for coalowners in Durham to get the cost of production of gas coals down to any great extent early. Coke is firm owing to the more limited output. Gas coke, though showing little change in price, is steady at 13s. to 13s. 6d. per ton f.o.b. for good makes.

Sales of Stocks and Shares.

The sale conducted by Messrs. A. & W. Richards at the Mart, Tokenhouse Yard, E.C., last Tuesday consisted of three new issues of capital. The first lots comprised £10,000 of 5 per cent. preference stock of the South Essex Water Company; and it was all placed at £112 10s. to £113 10s. per £100. Next came £4000 of additional ordinary 5 per cent. stock of the Harrow and Stanmore Gas Company, carrying 5½ per cent. from the 1st prox.; and it was sold at £105 to £108 per £100. The final lots consisted of 1000 "B" £10 shares (7 per cent.) in the Grays and Tilbury Gas Company, carrying £5 19s. per cent. from the 1st prox.; and they fetched £11 2s. 6d. each. At Rugby last week, Mr. J. R. Tait offered for sale 200 shares of £10 each in the Rugby Gas Company. They rank for a standard dividend of 7 per cent., subject to the sliding-scale; but on similar shares 11½ per cent. is being paid. They fetched from £22 to £23 10s. apiece.

Holyhead Council and the Water-Works.—A suggestion that the Holyhead Urban District Council should appoint a Committee to meet the Directors of the Water Company regarding a proposal to purchase the works was defeated at last week's meeting. The matter is, however, to be again brought before the General Purposes Committee. The Clerk remarked that the Company had always been ready to sell; but it would be necessary to go to Parliament for an Act before the transfer could be accomplished.

Abercarn Gas Supply.

The Abercarn Urban District Council, at a meeting last Tuesday, received a very satisfactory report from their Gas Engineer and Manager (Mr. Thomas Wilkinson) on the working of the gas undertaking in the year ended March 31. The make of gas was 37,011,500 cubic feet—an increase of 2,342,400 cubic feet on the previous year. The gross profit was £3169, against £3158, which (in spite of increases of £453 in the price of coal, £16 for repairs to mains, services, meters, &c., £31 for stokers' wages, and the reduction in the price of gas, which has meant a difference of £242) is £11 more than before. After paying off interest and the instalment of loans, amounting to £2231, also paying out of revenue for work of a capital nature amounting to £330, there was a net profit on the year's working of £607, against £695. Residuals receipts amounted to £1214, against £1072. The working results showed marked improvement. Up to Mr. Wilkinson taking charge in October last year the yield of gas per ton of coal had been 10,723 cubic feet; and now 11,250 cubic feet are being obtained, for which the Committee have expressed their deep appreciation; also the leakage has been reduced by 4·15 per cent. The Gas Committee (at which Mr. A. E. Meredith presided) recommended that the price of gas should be reduced by 3d., to 3s. 9d. per 1000 cubic feet, and to all persons using more than 40,000 cubic feet in one quarter by 6d., to 3s. 6d.; this reduction to take place from the 30th inst. The satisfactory character of last year's working was very gratifying; and they looked forward with confidence to the future, as the gas undertaking was now in an extremely good position.

Gas Explosion in Liverpool.—Four persons were injured (but happily two of them only very slightly) by a gas explosion in Liverpool last week. There was a leak in a house; and the new tenant, who had only been in it a few days, was, as a local paper picturesquely says, "searching for the seat of the mischief" when the explosion occurred. He was, we are told, "perhaps injudiciously," carrying a candle. In view of the fact that four persons were taken to the hospital, where two were detained, the injudiciousness of the action seems to be more than a possibility.

Hebden Bridge and Mytholmroyd Gas Board.—A joint meeting of the Hebden Bridge and Mytholmroyd District Councils has been held to consider the report on the gas undertaking. For the past year the gross profits on revenue account were £4476; and there was a net profit of £34, against £43 for the previous year. The stock issued and other capital borrowed to the end of the year was £104,300, towards the liquidation of which £26,758 has been set aside. The profit accumulated since the two Councils took over the works from the old Gas Company in 1895 amounts to £7262, £1800 of which has been paid to them. A sum of £11,197 was spent on capital account during last year. Mr. Simpson (the Chairmain) pointed out that the Board had had many difficulties to contend with.

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Bolton Gas Charges.

At the last meeting of the Bolton Town Council, Mr. Potts, speaking on the minutes of the Gas and Lighting Committee, said he was not satisfied with the 1d. per 1000 cubic feet reduction in the price of gas to all consumers. He hoped it would be possible to make a reduction year after year. He was not finding fault with the Gas Committee, but with the Council, who would have £20,000 a year from the Committee for the relief of the rates. Mr. Cheadle said the Gas Committee had relieved the general ratepayers to practically the same extent as last year, because they had found £850 in aid of establishment charges. He was inclined to think that the increased consumption which would have occurred if the full reduction had been given would have enabled the department to make sufficient profit to pay £20,000 in aid of the rates. He moved that the matter be referred back. Mr. Peters, who seconded, argued that the present reduction was too small to bring in any new consumers. Mr. Ritson said that during 1913 the cost of gas into the holder was 8½d. per 1000 cubic feet; and this year it would probably be 1½d. more. It had always seemed strange to him that gas which cost from 8½d. to 10d. per 1000 feet into the holder should be sold at 2s. 4d.; but he hoped for further concessions. Alderman Miles thought the Committee ought to have delayed for another year making any reduction. Mr. Harding said it was the intention of the Committee to double the reduction next year, if they had a successful balance-sheet; and on this understanding the amendment was withdrawn and the minutes passed.

Water-Works Purchase Question at Kenilworth.—The Kenilworth Urban District Council have passed a resolution, "That the Council at once take into consideration the advisability of the purchase of the Water Company, or by some other means of securing an efficient water supply for the town."

Liverpool and the Fazakerley Works.—At a meeting of the West Derby Board of Guardians, the Chairman (Mr. T. C. Welding) referred with satisfaction to the fact that, owing to the representations of the residents of Fazakerley, the Liverpool Corporation had agreed to sell their gas-works at Fazakerley to the Liverpool United Gaslight Company. He understood that within a short time the price would be reduced by 5d. per 1000 cubic feet, and the quality improved.

Nottingham Water Undertaking.—The Water Committee of the Nottingham City Council did not find themselves free from difficulties when presenting their annual report [noticed in the "JOURNAL" last week] at a meeting of the Council on Monday last week. The redeeming features, however, were that, after providing £24,158 to the expenses of the Joint Board, a net profit of £5669 remained on the year's working, and that for the fourth annual period in succession the undertaking had been carried on without any addition to its capital expenditure. The report was adopted upon the proposal of the Chairman of the Committee (Mr. A. R. Atkey).

Water Scheme for Barlby.—A Local Government Board inquiry was held at Barlby, near Selby, last Thursday, by Mr. F. O. Stanford, with reference to an application by the Riccall Rural District Council to borrow £3810 to carry out a scheme of water supply for Barlby. It is proposed to take water from the Selby Water-Works at a cost of 9d. per 1000 gallons, and carry it by means of two 6-inch pipes across the bed of the River Ouse to the Barlby side.

Proposed Purchase of the Builth Gas-Works.—The Builth Urban District Council propose to purchase the local gas-works, and for this purpose are convening a public meeting of ratepayers to finally settle the question. If it is found that the undertaking can be acquired at a reasonable figure, and a great amount of money will not be needed at an early date to be spent on renewals, it is anticipated that the townspeople will be quite agreeable to the purchase being effected.

Delivery of Gas-Stoves.—In the "Bristol Times and Mirror" for the 6th inst. the following paragraph appeared: "A new motor service, London to Bristol, is quite a novel development of modern traction. A good deal of interest was shown in a large motor van which arrived in the city yesterday. It is the first of a new service inaugurated by Messrs. R. & A. Main, of London, Bristol, &c.; and it left Messrs. Main's works at Edmonton, London, on Thursday at mid-day with a consignment of 'Main' enamelled gas-cookers for the Bristol Gas Company. It is hoped to continue this service in future at regular intervals, which will no doubt be good news for gas consumers in Bristol and the West."

Salford Gas Profits.—The Salford Gas Committee have adopted a resolution to the effect that, inasmuch as the revenue of the gas undertaking for the year ended March 31 last is insufficient to enable the Corporation to pay the sum of £10,000 to the credit of the district fund of the borough, as is required by the Salford Order, 1912, and the reserve fund being insufficient for such purpose, the Council be recommended to pay out of the district fund of the borough, in pursuance of the Order, the sum of £9293 5s. 4d., into the revenue of the gas undertaking, to make up the said sum of £10,000; such sum of £9293 5s. 4d. to be a debt due to, and to be repaid to, the district fund out of the future revenue of the gas undertaking.

Price of Gas to Manchester Prepayment Consumers.—At Wednesday's meeting of the Manchester City Council, a resolution was rejected requesting the Gas Committee to consider the advisability of extending more generous treatment to users of gas supplied through slot-meters. The Council's decision was undoubtedly influenced by the remarks of the Chairman of the Committee (Mr. W. Kay, J.P.), who claimed that Manchester gave as much gas for the money as any place in the kingdom, having regard to their conditions. Manchester, he said, had to bear the cost of the meter, cooker, fixing, and collection of money—the latter amounting to 215 tons of coppers every year. From 71,000 slot-meter consumers, there was not a single complaint. As to the business point of view, he could not give any hope that anything would come of the resolution if it were carried.

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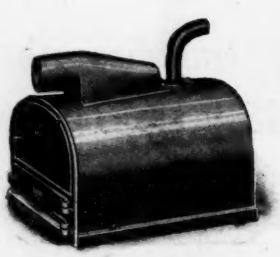

The "DAISY."

Richmond

Heating Engineers,
LONDON AND
WARRINGTON.

Gas-Workers' Dispute at Hebden Bridge.—Trouble arose last week at the Hebden Bridge and Mytholmroyd Gas-Works. Certain of the men declined to perform extra duties on Wednesday night, with the result that the following morning the yard men were all locked out. It was stated by one of the workmen that the situation threatened serious difficulties, because most of the members of the staff were said to be in sympathy with their locked-out comrades. A special meeting of the Board has been called to deal with the situation.

Lighting of Lurgan.—The Finance Committee of the Lurgan Urban Council reported to the last meeting of that body that they had held over the Gas Company's account for lighting public lamps, which was stated at £374, against £364 in the previous year. The Clerk said there had been a good deal of heckling at the recent inquiry over this question of public lighting. It was stated by some of the parties that the reason the gas account had increased was because of the lighting of the lamps for the workers from 5.30 to 7.30 a.m. in certain months; but, though during the past winter the factories were on short time, and did not start until 8.30 a.m., and the lamps were only lighted for half the season, the account was £10 more than last year, and £76 more than for 1912. The burners had been tested by the Gas Company. Mr. Pedlow said, this being so, they must accept the Company's figures. It was decided to request the Finance Committee to go further into the matter and to report fully.

Oldbury Gas-Works Management.—The Oldbury Urban District Council have agreed to hold a special meeting for the purpose of a full inquiry into the management of the gas-works. Mr. Robbins complained of the manner in which he had been treated with regard to a question he raised at the last Council meeting relating to the gas undertaking. He said he was asked to refer to the matter at the Gas Committee meeting; and when he did so, he was practically told he had an axe to grind. He did not think he was having a fair hearing.

Belfast Electricity Inquiry.—The Belfast Corporation have adopted the recommendation of Alderman Sir R. Anderson, Alderman J. S. Finnigan, and Mr. R. Meyer, the Town Clerk, for the appointment of Mr. J. F. C. Snell, President of the Institution of Electrical Engineers, and Mr. W. J. Batten, formerly engineering manager of Messrs. Harland and Wolff, Limited, to furnish separate reports on the condition of the plant at the electricity generating station and the further development of the undertaking. Complaint, it may be recalled, had been made by a member of the Council regarding the plant and the management of the power station; and a Committee appointed by the Council had held an inquiry. Councillor Curley described the undertaking as in "a deplorable state," and "going from bad to worse." Mr. Alexander said the report of evidence taken already made deplorable reading. Alderman Finnigan, in reply, urged that statements had been made which were not supported by proof.

GAS COMPANIES IN THE STOCK EXCHANGE.

The Stock Exchange has had a curious and instructive week, unhappily ending in disappointment. The feeling at first was highly apprehensive as to what might be the immediate sequel of the momentous announcement of failures on the previous Saturday. But markets gradually gathered courage, cheered by the promise of an easy settlement, so that by midweek the Consols barometer showed a rise of $\frac{5}{8}$. Then suddenly the tendency turned completely round, dismayed by the more threatening aspect of the Irish question, the imminent recrudescence of Balkan trouble, and the French financial difficulty. Consequently, all the gains in the first half of the week were lost, and a bit more too in most markets. Business was reduced to most meagre proportions; and many judged it safest to do nothing at all. The opening was extremely quiet and cautious. Consols were sold down to $73\frac{3}{8}$. But before the end of the day some recovery set in. Rails gathered strength, Foreign showed some firmer spots, and Transatlantics found local support. Business was still inactive on Tuesday, but the tendency was good. Government issues were bought, and Consols advanced $\frac{1}{4}$. Prices of Rails were better all through the list. Wall Street bought Transatlantics, and Continental buyers went for their favourites. The roseate complexion of affairs lasted through Wednesday. Gilt-edged securities were strong, and Consols rose $\frac{3}{8}$, aided by gold movements and weakening discount. Rails continued buoyant, and most of the rest kept step. The settlement was satisfactorily concluded on Thursday; but markets had a disagreeable set-back. Government issues were very weak, and Consols receded $\frac{3}{8}$. Rails fell in price under pressure to sell. Foreign were flat, and Transatlantics lethargic. On Friday, things went from bad to worse; great apprehension being evinced at the aspect of the sinister factors noted above. Prices were put down freely in discouragement of sales. Consols fell another $\frac{1}{4}$, Rails were very weak, and of the rest only American kept up. The fall of the Ribot Government came as a final shot on Saturday; and markets preserved the utmost caution in expectation of Continental sales. But things did not turn out so bad as had been feared, though Consols fell another $\frac{1}{8}$, closing at $73\frac{3}{8}$ to $73\frac{5}{8}$—after having touched $73\frac{1}{4}$. In the Money Market, the easier movement in rates continued in progress. Business in the Gas Market was quieter than ever, even the biggest issue counting fewer than a dozen transactions; and there were few changes in quotation except for *ex div.* adjustment. In Gas Light and Coke, the ordinary changed hands at $101\frac{1}{2}$ to $102\frac{1}{4}$. In the secured issues, the maximum realized $77\frac{3}{4}$ and $78\frac{3}{4}$, the preference $97\frac{1}{2}$ to $98\frac{3}{4}$, and the debenture $74\frac{1}{2}$ *cum div.* and 73 *ex div.* South Metropolitan marked the same figures as the week before—110 to 111—and the debenture fetched 74 to $75\frac{1}{2}$. In Commercials, the 4 per cent. was done at 106, and the $3\frac{1}{2}$ per cent. at $104\frac{1}{2}$. Among the Suburban and Provincial group, Alliance and Dublin realized $62\frac{1}{2}$, Bournemouth "B" $15\frac{1}{2}$, ditto preference $13\frac{9}{16}$, British $44\frac{3}{8}$, Hastings $88\frac{1}{2}$, South Suburban 115 to $115\frac{1}{2}$, Tottenham "A" $135\frac{1}{2}$, and ditto "B" 117. In the Continental companies, Imperial marked 162 to $163\frac{3}{4}$, ditto debenture $84\frac{1}{2}$, Union 80, and European $18\frac{3}{8}$. Among the undertakings of the remoter world, Bombay made $6\frac{1}{4}$, Cape Town $1\frac{1}{2}$, ditto preference 5, Monte Video $11\frac{3}{4}$, Oriental $119\frac{3}{4}$, Primitiva 6 and $6\frac{5}{16}$, ditto preference 5 to $5\frac{5}{32}$, and ditto debenture $92\frac{1}{4}$ and $92\frac{3}{4}$.

OFFICIAL QUOTATIONS AT THE CLOSE OF THE WEEK.

Bank Rate (fixed January 29), 3 per cent. Last year, $4\frac{1}{2}$ per cent. Consols, $73\frac{3}{8}$—$73\frac{5}{8}$. Previous week, $73\frac{1}{2}$—$73\frac{3}{4}$.

Issue.	Share.	When ex Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,551,868	Stk.	April 8	$2\frac{1}{2}$	Alliance & Dublin Ord.	61—66	..	3 15 9
374,000	,,	Jan. 15	4	Do. 4 p.c. Deb.	73—81	..	4 12 9
280,000	5	April 29	$7\frac{1}{2}$	Bombay, Ltd.	$5\frac{1}{4}$—$6\frac{3}{4}$	..	5 17 8
50,000	10	Feb. 26	16	Bourne- | 10 p.c.	29—30	..	5 6 8
852,500	10	,,	7	mouth Gas | B 7 p.c.	15—$15\frac{1}{2}$	..	4 10 4
75,000	10	,,	6	and Water | Pref. 6 p.c.	$13\frac{1}{2}$—14	..	4 5 9
380,000	Stk.	Feb. 26	14	Brentford Consolidated	260—265	..	5 5 8
330,000	,,	,,	11	Do. New	204—209	..	5 5 8
50,000	,,	,,	5	Do. 5 p.c. Pref.	109—111	..	4 10 1
206,250	,,	June 11	4	Do. 4 p.c. Deb.	91—93*	..	4 6 0
217,380	Stk.	Feb. 26	11	Brighton & Hove Orig.	207—212	..	5 3 9
244,200	,,	,,	8	Do. A Ord. Stk.	153—158	..	5 1 3
530,000	20	Mar. 26	$12\frac{1}{2}$	British	44—45	..	5 11 1
120,000	Stk.	Dec. 30	4	Do. 4 p.c. Deb. Stk.	90—92	..	4 7 0
245,771	Stk.	,,	4	Buenos Ayres 4 p.c. Deb.	89—91	..	4 7 11
100,000	10	—	—	Cape Town & Dis., Ltd.	$1\frac{1}{2}$—$2\frac{1}{2}$	..	—
100,000	10	—	—	Do. $4\frac{1}{2}$ p.c. Pref.	5—6	$-\frac{1}{2}$	—
100,000	Stk.	Dec. 30	$4\frac{1}{2}$	Do. $4\frac{1}{2}$ p.c. Deb. Stk.	73—78	..	5 15 5
157,150	Stk.	Feb. 26	5	Chester 5 p.c. Ord.	108—110	..	4 10 11
1,513,280	Stk.	Feb. 12	5/9/4	Commercial 4 p.c. Stk.	106—108	..	5 1 2
560,000	,,	,,	$5\frac{1}{2}$	Do. $3\frac{1}{2}$ p.c. do.	$103\frac{1}{2}$—$105\frac{1}{2}$	..	5 1 1
475,000	,,	June 11	8	Do. 3 p.c. Deb. Stk.	$69\frac{1}{2}$—$71\frac{1}{2}$*	..	4 8 11
800,000	Stk.	,,	4	Continental Union, Ltd.	78—81*	..	4 18 9
200,000	,,	,,	7	Do. 7 p.c. Pref.	$113\frac{1}{2}$—$116\frac{1}{2}$*	−1	6 0 2
492,270	Stk.	—	6	Derby Con. Stk.	123—125	..	4 16 0
55,000	,,	—	4	Do. Deb. Stk.	102—104	..	3 16 11
1,002,180	10	Jan. 15	10	European, Ltd.	18—$18\frac{1}{2}$	..	5 8 1
16,386,660	Stk.	Feb. 12	4/17/4	Gas | 4 p.c. Ord.	101—108	..	4 14 7
2,600,000	,,	,,	$3\frac{1}{2}$	Light | $3\frac{1}{2}$ p.c. max.	76—79	..	4 8 7
4,062,235	,,	,,	4	and | 4 p.c. Con. Pref.	96—99	..	4 0 10
4,674,850	,,	June 11	3	Coke | 3 p.c. Con. Deb.	72—74*	..	4 1 1
258,740	Stk.	Mar. 12	5	Hastings & St. L. $3\frac{1}{2}$ p.c.	87—89	..	5 12 4
70,000	10	April 29	11	Hongkong & China, Ltd.	$16\frac{1}{2}$—$16\frac{3}{4}$	..	6 11 4
131,000	Stk.	Mar. 12	$7\frac{3}{8}$	Ilford A and C	151—154	..	4 19 0
65,780	,,	,,	$6\frac{1}{2}$	Do. B	115—118	..	5 3 10
65,500	,,	Dec. 30	4	Do. 4 p.c. Deb.	94—96	..	4 3 4
4,940,000	Stk.	May 14	9	Imperial Continental	162—167	..	5 7 9
1,235,000	Stk.	Feb. 12	$3\frac{1}{2}$	Do. $3\frac{1}{2}$ p.c. Deb. Red.	84—86	..	4 1 5
200,242	Stk.	Mar. 12	$6\frac{1}{2}$	Lea Bridge Ord. 5 p.c.	119—121	..	5 7 5
561,000	Stk.	Feb. 26	10	Liverpool United A	211—213	..	4 13 11
718,100	,,	,,	7	Do. B	144—146	..	4 15 11
306,083	,,	Dec. 30	4	Do. Deb. Stk.	99—101	..	3 19 3
63,480	Stk.	Dec. 30	3	Maidstone 3 p.c. Deb.	65—67	..	4 9 7

Issue.	Share.	When ex Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
75,000	5	June 11	6	Malta & Mediterranean	$4\frac{1}{2}$—$4\frac{5}{8}$*	..	6 9 9
250,000	100	April 1	$4\frac{1}{2}$	Met. of | $4\frac{1}{2}$ p.c. Deb. Melbourne	99—101	..	4 9 1
541,920	20	May 28	4	Monte Video, Ltd.	$11\frac{3}{8}$—$12\frac{1}{2}$	..	6 13 1
1,775,892	Stk.	Feb. 26	$4\frac{1}{2}$	Newc'tle&G'tesh'd Con.	$99\frac{1}{2}$—$100\frac{1}{2}$	$+\frac{1}{4}$	4 9 7
529,705	Stk.	Dec. 30	$3\frac{1}{2}$	Do. $3\frac{1}{2}$ p.c. Deb.	$83\frac{1}{2}$—$84\frac{1}{2}$	..	4 2 10
55,940	10	Feb. 26	7,14/0	North Middlesex 7 p.c.	14—15	$+\frac{1}{2}$	5 2 8
300,000	Stk.	May 14	8	Oriental, Ltd.	117—122	..	6 11 2
60,000	5	Mar. 26	10	Ottoman, Ltd.	$7\frac{1}{4}$—$7\frac{3}{4}$	..	6 9 0
60,000	50	Feb. 26	$12\frac{1}{2}$	Portsea, Island B	128—131	..	4 19 3
100,000	50	,,	12	Do. C	118—121	..	4 19 2
249,980	5	April 29	8	Primitiva Ord.	$5\frac{3}{4}$—$6\frac{1}{4}$	$-\frac{1}{4}$	6 8 0
499,960	5	Dec. 30	5	,, 5 p.c. Pref.	5—$5\frac{1}{2}$	..	4 15 3
621,600	100	June 2	4	,, 4 p.c. Deb.	91—93	..	4 6 0
346,198	Stk.	Dec. 30	4	River Plate 4 p.c. Deb.	87—89	..	4 9 11
150,000	10	May 14	6	San Paulo | 6 p.c. Pref.	$10\frac{1}{2}$—11	..	5 9 1
125,000	50	Jan. 2	5	San Paulo | 5 p.c. Deb.	48—50	..	5 0 0
135,000	Stk.	Mar. 12	10	Sheffield A	293—294	..	4 9 8
209,984	,,	,,	10	Do. B	292—294	..	4 9 3
523,500	,,	,,	10	Do. C	292—294	..	4 9 3
90,000	10	May 28	9	South African	$10\frac{1}{2}$—$11\frac{1}{2}$	..	7 16 6
6,429,895	Stk.	Feb. 12	5/9/4	South Met., 4 p.c. Ord.	109—111	..	4 18 6
1,895,445	,,	Jan. 15	3	Do. 3 p.c. Deb.	74—76	$+\frac{1}{2}$	3 18 11
209,820	Stk.	Feb. 26	$8\frac{1}{2}$	South Shields Con. Stk.	157—159	..	5 6 11
952,795	Stk.	Feb. 26	6	S'th Suburb'n Ord. 5 p.c.	114—116	..	5 3 5
60,000	,,	,,	5	Do. 5 p.c. Pref.	110—112	..	4 9 3
117,058	,,	Dec. 30	5	Do. 5 p.c. Deb. Stk.	113—115	..	4 6 11
629,740	Stk.	May 14	5	Southampton Ord.	99—102	..	4 18 0
120,000	Stk.	Feb. 12	$7\frac{3}{8}$	Tottenham | A 5 p.c.	135—138	..	5 6 10
543,940	,,	,,	$5\frac{1}{4}$	District | B $3\frac{1}{2}$ p.c.	115—117	..	5 0 5
149,470	,,	Dec. 30	4	District | 4 p.c. Deb.	89—91	..	4 7 11
182,380	10	,,	5	Tuscan, Ltd.	5—6	..	8 6 8
149,900	10	Jan. 2	5	Do. 5 p.c. Deb. Red.	95—97	..	5 3 1
236,476	Stk.	Mar. 12	5	Tynemouth, 5 p.c. max.	$108\frac{1}{2}$—$109\frac{1}{2}$	..	4 11 4
				Wandsworth, Wimbledon, and Epsom—			
30,000	Stk.	Feb. 26	$8\frac{3}{8}$	Wandsworth A 5 p.c.	151—156	..	5 7 4
255,636	,,	,,	$6\frac{3}{8}$	,, B $3\frac{1}{2}$ p.c.	129—134	..	5 2 7
108,075	,,	,,	5/17/3	,, C $3\frac{1}{2}$ p.c.	110—115	..	5 2 0
352,000	,,	,,	$6\frac{1}{2}$	Wimbledon 5 p.c.	117—122	..	5 0 5
98,000	,,	,,	$6\frac{3}{8}$	Epsom 5 p.c.	121—126	..	5 5 2
88,416	,,	Dec. 30	3	3 p.c. Deb. Stk.	68—71	..	4 4 6

Prices marked * are "Ex Div."

Cost of Nelson's New Reservoir.—The award of the Arbitrator in connection with the dispute between the Nelson Corporation and the contractors for the construction of the new reservoir at Ogden was made known last Friday. The original contract was for £35,000, and provision was made for an additional payment for work certified to be necessary. The Corporation admitted their liability for additional work to the extent of £7000; but the contractors (Messrs. White) preferred to submit the matter to arbitration. Under the award the Corporation have to pay £50,550, or £14,000 for the extra work, which is £7000 more than was anticipated. The new reservoir will hold 160 million gallons, and will serve Nelson, Brierfield, Barrowford, and the district.

The Carron Company yesterday removed their London west-end show-room business from No. 23 Princes Street and No. 3, Berners Street, to new premises at No. 50, Berners Street, Oxford Street, W.

The Provincial Incandescent Fittings Company, Limited ("Pifco") are removing to a building standing in its own ground comprising five storeys (including basement) situated at No. 71, High Street, N., Manchester, a minute's walk from their present address.

The Goole Gas and Water Committee are taking steps to secure a report on the present manufacturing plant at the Goole Gas-Works, its possible development having regard to the restricted area, and the best method of utilizing the available space with a view to considerably increasing the output and reducing the carbonizing cost.

At a meeting of the Carlisle Rural District Council, a report was presented by the Engineer on the proposed water scheme for the district under the administration of the Council. The estimated cost was stated to be £59,250. The area to be supplied consists of fifteen parishes, with a population of 12,327. The source of supply is from Roughton Gill, on Colbeck Fell, at an altitude of 1294 feet above Ordnance Datum. A resolution adopting the scheme was passed.

In the description of the centrally suspended high-power low-pressure gas-lamps in the City of London, as given on p. 492 in the issue of the "JOURNAL" for May 19, it might have been mentioned that the automatic joint-suspender used in the installation is the London Electric Firm's patent, already described by us. This auto-joint will withstand pressures up to 300 inches (water-gauge); and it embodies a weight-relieving feature which automatically transfers the weight of the lamp from the hauling wire to the large suspension rope.

At the Philosophical Hall, Leeds, last week, Mr. Fredk. Dye (a member of the Royal Institution) lectured on "Domestic Hot Water Supply and the Application of the Gas-Boiler." Alderman W. Penrose-Green (the Chairman of the Leeds Corporation Gas Committee) presided, and spoke strongly in favour of the use of gas for domestic heating purposes. The lecturer made reference to the service of the gas-boiler in facilitating the use of the gas cooking-stove. Once it was, he said, fully realized by the public at what a low cost the gas-boiler could heat household water, this boiler would quickly become a companion of the gas-cooker.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

DISTRIBUTION SUPERINTENDENT. Airdrie Gas Department. Applications by June 20.
SHOW ROOM ATTENDANT. No. 5896.
MECHANIC. No. 5897.

Appointment, &c., Wanted.

WORKING MANAGER. No. 5898.

Gas-Works Wanted.

"D. G.," c/o Scripps's Advertising Offices.

Plant, &c. (Second Hand), for Sale.

BUILDINGS, IRONWORK, CONDENSERS, WASHERS, &c. Nottingham Gas Department. Tenders by June 23.

Meeting.

INSTITUTION OF GAS ENGINEERS. St. George's Hall, Liverpool. June 16, 17, 18.

Patent Licences, &c.

METERS. Haseltine, Lake, and Co., Southampton Buildings, W.C.
REGULATORS FOR WATER-HEATERS. F. Bosshardt and Co., 4, Corporation Street, Manchester.

Sales of Stocks and Shares.

HEMEL HEMPSTED GAS COMPANY. London Mart. June 30.
HERNE BAY GAS AND ELECTRICITY COMPANY. London Mart. June 23.
ST. ALBANS WATER COMPANY. London Mart. June 30.
SOUTH SUBURBAN GAS COMPANY. London Mart. June 30
SOUTHEND WATER COMPANY. London Mart. June 23.
SOUTHGATE GAS COMPANY. London Mart. June 23.
WORTHING GAS COMPANY. London Mart. June 23.

TENDERS FOR

Coal.

BARNOLDSWICK GAS AND WATER DEPARTMENT. Tenders by June 30.
BLACKPOOL GAS DEPARTMENT. Tenders by June 23.
CHELTENHAM GASLIGHT AND COKE COMPANY. Tenders by June 25.
CONNAH'S QUAY GAS AND WATER COMPANY. Tenders by June 25.
COVENTRY GAS DEPARTMENT. Tenders by June 29.
EAST RETFORD GAS DEPARTMENT. Tenders by July 4.
GAINSBOROUGH GAS DEPARTMENT. Tenders by June 20.
HINCKLEY GAS DEPARTMENT. Tenders by June 20.
NORTHWICH GAS COMPANY. Tenders by July 1.
WILMSLOW AND ALDERLEY EDGE GAS COMPANY. Tenders by June 29.
WORKINGTON CORPORATION. Tenders by June 22.

Gas Controllers.

DUBLIN CORPORATION. Tenders by June 23.

General Stores (Lime).

HINCKLEY GAS DEPARTMENT. Tenders by June 20.

Oil for Gas Making.

MANCHESTER GAS DEPARTMENT. Tenders by June 25.

Retorts, &c.

LYMM URBAN DISTRICT COUNCIL. Tenders by June 22.

Tar and Liquor.

BRIDGEWATER COLLIERY COKE-WORKS. Tenders by June 22.
WARE GASLIGHT COMPANY. Tenders by July 1.
WILMSLOW AND ALDERLEY EDGE GAS COMPANY. Tenders by June 29.

BOOKS AND LEAFLETS

TO BE OBTAINED OF

WALTER KING,

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REPORTS OF DISTRICT ASSOCIATIONS OF GAS ENGINEERS AND MANAGERS FOR 1913. *Price 5s. 6d.*

CONSPIRACY AND PROTECTION OF PROPERTY ACT.—*Price 2s. per dozen*, or 10s. 6d. *per* 100; printed on broadsides sheets.

THE COMPOSITION AND USE OF GAS LIME IN AGRICULTURE.—By (the late) Dr. VOELCKER, Professor of Chemistry to the Royal Agricultural Society of England. *Price 5s. per* 100.

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BIRMINGHAM CORPORATION (Windsor Street) GAS-WORKS.—By CHARLES HUNT, M.Inst.C.E. *Price 21s.*

METHODS OF GAS ANALYSIS.—By Dr. WALTHER HEMPEL. Translated from the third German edition and considerably enlarged by L. M. DENNIS. *Price 10s.*

GAS MANUFACTURE AND GAS LIGHTING.—By HENRY O'CONNOR, Assoc.M.Inst.C.E., &c. A Course of Five Lectures delivered before the Royal Scottish Society of Arts. *Price 1s. 6d. post free in the United Kingdom.*

COAL TAR AND AMMONIA.—By GEORGE LUNGE, Ph.D. Fourth Edition in Two Parts. *Price 42s.*

ANALYSES OF SCOTCH COALS, CANNEL, SPLINT, SHALE, &c., USED IN THE MANUFACTURE OF GAS.—By (the late) Dr. WILLIAM WALLACE, of Glasgow. *Price 1s.*

RATING OF GAS AND WATER UNDERTAKINGS.—By ARTHUR VALON, Assoc.M.Inst.C.E. *Price 3s. 6d. net.*

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